Railway Engineering and Maintenance

March, 193

RAIL ANTI CREEPERS

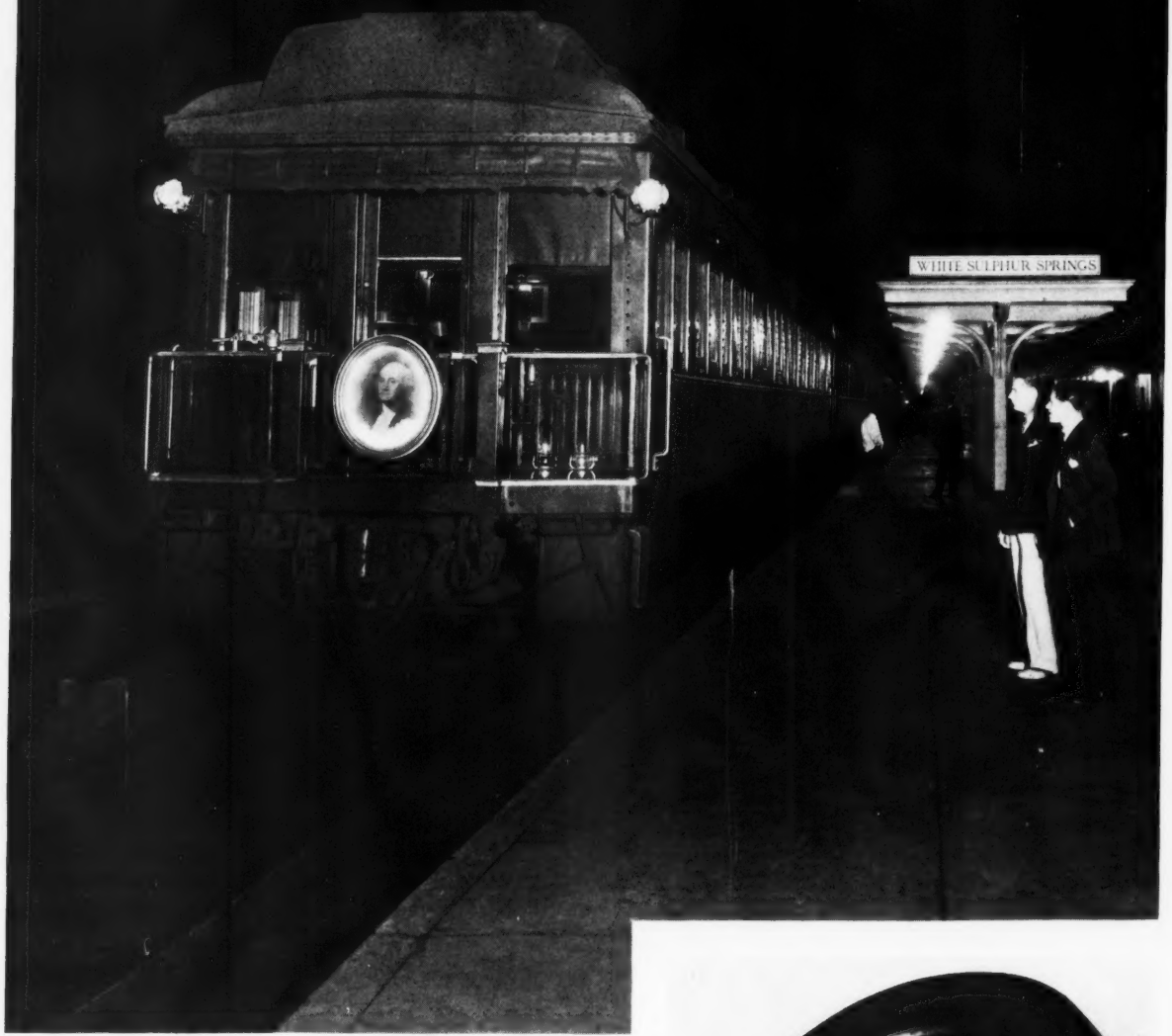
THE USE

OF AN ADEQUATE NUMBER OF RAIL ANTI-CREEPERS ASSURES BETTER AND SAFER TRACK WITH ATTENDANT SAVINGS IN MAINTENANCE EXPENDITURES

CHICAGO THE P & M CO. NEW YORK

MONTREAL • PARIS • CALCUTTA • SIDNEY • LONDON

Reliance HY-CROME *Spring Washers*



THE GEORGE WASHINGTON ONE OF AMERICA'S FAMOUS TRAINS

WHETHER hot or cold outdoors, it is always spring-time inside the completely air conditioned GEORGE WASHINGTON, Chesapeake & Ohio crack train. Completely air conditioned cars are operated between New York and Louisville; between Washington and Cincinnati, Louisville, Chicago and St. Louis; and between Old Point Comfort and Cincinnati and Chicago . . . Pioneering this equipment, the C & O definitely proved that rail travel can be far safer, cleaner and more comfortable than any other means of mass transportation on land. Proper maintenance of rail joints and road bed contributes to the comfort and safety of this train.

EATON MANUFACTURING COMPANY

RELIANCE SPRING WASHER DIVISION

MASSILLON, OHIO

Sales Offices: New York, Cleveland, Detroit, Chicago, St. Louis, San Francisco, Montreal

Published monthly by Simmons-Boardman Publishing Company, 105 W. Adams St., Chicago, Ill. Subscription price, United States and Possessions, $2.00; Canada, $2.50; Foreign, $3.00. Single copies 25 cents. Entered as second class matter January 20, 1933, at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mt. Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

These Rounded Steps of Resistance Prevent the Spreading of Track...

The LUNDIE Stepped, Non-Cutting, Non-Slip Base . . .

The Lundie Tie Plate is by far the most scientifically designed and practically efficient tie plate ever evolved. And here's why. It not only maintains correct gauge, cants the rail at the desired inclination but protects the ties against mechanical destruction and prolongs their life in track.

The base consists of a number of seats joined by gentle curves and parallel to the upper surface of the plate. With this design, all bearing surfaces, namely the base of the rail, the top and bottom surfaces of the tie plate, and the top surface of the tie, are all at right angles to the resultant load. With all bearing surfaces normal to the resultant thrust, the Lundie Plate is instrumental in minimizing the effect of the impact of the lateral thrusts of unbalanced locomotives and the wheel flange pressure on curves, and the tendency of the plate to slip is eliminated.

The significant fact is that all this is accomplished without sacrificing any tie life through the use of destructive cutting projections.

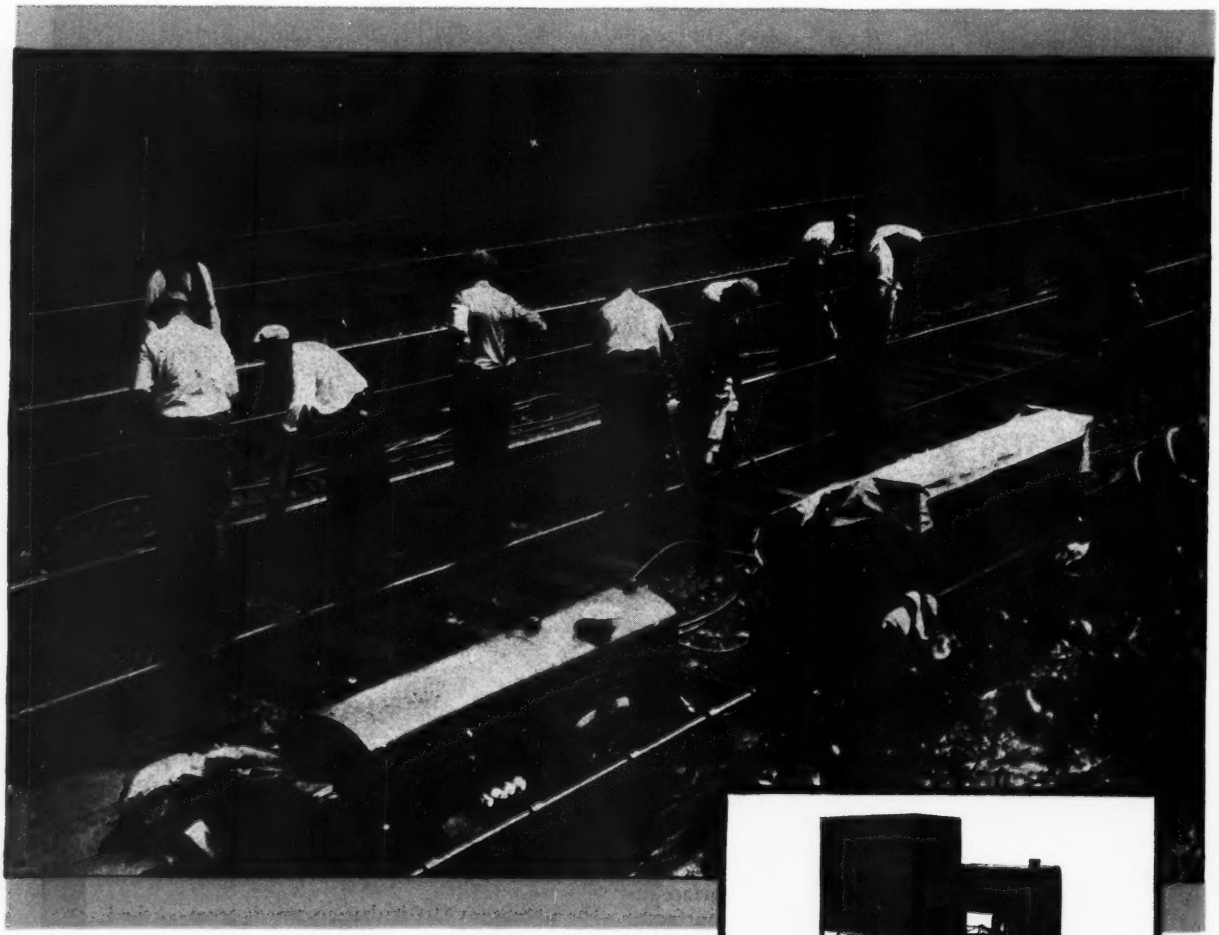
The Lundie Engineering Corporation

Tie Plates—Ardco Rail and Flange Lubricator

285 Madison Avenue, New York 59 East Van Buren St., Chicago

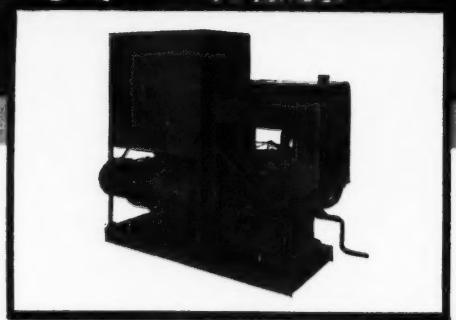
LUNDIE TIE PLATE

THEY FOUND $207.00 PER MILE



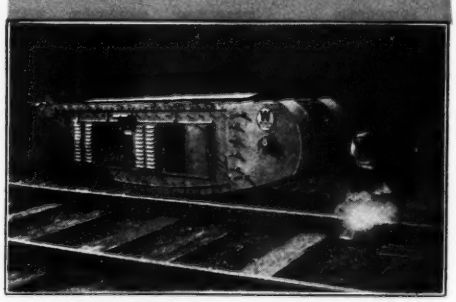
Above—*A Syntron 8-tool Electric Tie Tamping Outfit. Its power plant contains a Westinghouse generator and control.*

(*Photo by courtesy of Syntron Company*)



Right—*Westinghouse Portable Gas-Electric Sets for powering maintenance-of-way tools are available for every requirement.*

Westinghouse Tractor Welders, similar to this, are equipped to furnish electric power for welding, operating small tools, and for lighting.



ALONG THEIR TRACKS
with Electric Tie Tampers

AN Eastern railroad conducted a one-season test with electric tie tampers and kept accurate records of their costs. At the end of this period they found that these tools had saved an average of $207 per mile annually over hand-tamping.

But tie tamping is only one of the many maintenance-of-way operations where electricity can effect important savings.

One railroad has definitely proved that electric arc welding of battered rail ends saves them 55 cents per joint over other welding methods previously employed.

On another railroad, electric nut tighteners have stepped-up this operation to a point where a four-bolt joint is completed in thirty seconds.

We could mention many more examples, but the point is this: *Intensive use of electrically powered portable tools in every phase of roadway maintenance will effect savings which you cannot afford to ignore.*

Westinghouse

Quality workmanship guarantees every Westinghouse product

Check up on *your* maintenance-of-way costs. Find out where you can save money by using these modern tools.

Let us send you a copy of the 60-page book illustrated below. It will help you in making a thorough check-up of facilities in every branch of your Maintenance-of-Way and Shop Departments. Mail the coupon for your copy.

GET THIS VALUABLE BOOK

Westinghouse Electric & Manufacturing Company
Room 2-N East Pittsburgh, Pa.

Gentlemen: Send C. 1966, Electrical Equipment for Railroad Shops and Maintenance of Way.

Name.....

Company.....

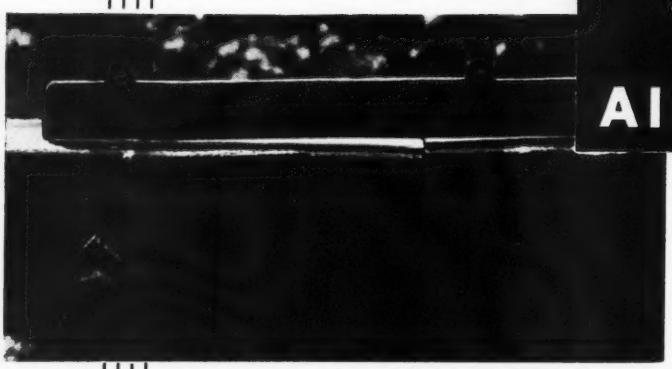
Position..... T 78987

Address..... RE&M 3-34

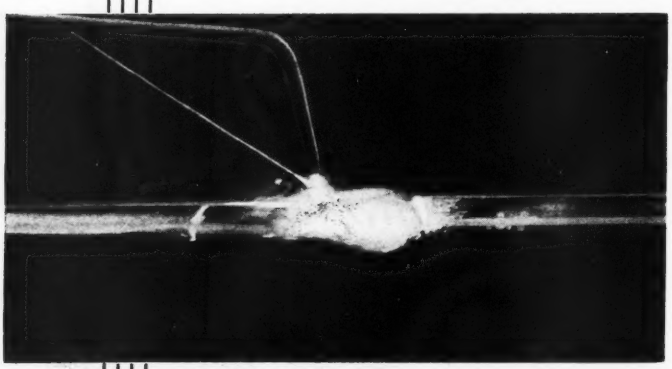
BUILD UP your RAIL ENDS

in half the time with 40% less gases by

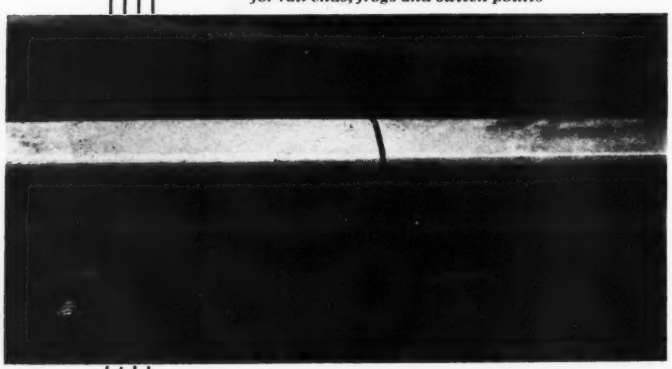
AIRCOWELDING



Straight edge shows the amount of building up to be done on these battered rail ends



AIRCOWELDING in progress. Best results are assured by using AIRCO-DB R. R. Rod, which was developed especially for rail ends, frogs and switch points



Completed rail end, good as new and ready for hard service

AIRCOWELDING is a simpler, faster oxyacetylene welding process. It was originated and developed by AIRCO Research Laboratories and perfected first for pipe welding. It has revolutionized the welding of pipe by cutting welding time in half and reducing gas consumption from 40 to 50 percent. This is not a claim. It stands definitely proved in widespread usage.

NOW the way is clear for Maintenance of Way Departments to secure these same exceptional savings in time and gases in the building up of rail ends through the use of the AIRCOWELDING process. **For the application of the process to this work has been perfected and, in line with AIRCO'S standard policy, results have been thoroughly substantiated in the laboratory and in the field before general announcement.**

You must see AIRCOWELDING being done to appreciate how much easier it is to apply and how much faster. AIRCO'S RAILROAD DEPARTMENT will be glad to demonstrate AIRCOWELDING to officials of Maintenance of Way Departments, on request.

NRA MEMBER U.S. WE DO OUR PART

AIR REDUCTION

General Offices: 60 East 42nd St., New York, N. Y.

A NATION-WIDE OXYACETYLENE WELD-

AIRCO OXYGEN. ACETYLENE. NITROGEN. HYDROGEN .

AIRCO NATIONAL CARBIDE .

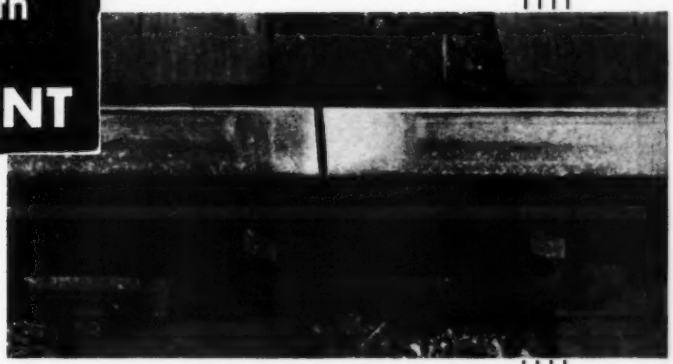
HEAT TREAT your RAIL ENDS

and make them last as long as the rails, with AIRCO EQUIPMENT

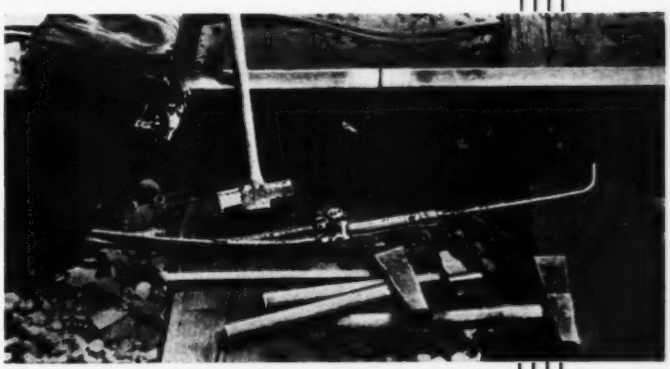
The most economical way to build up battered rail ends is by the AIRCO-WELDING process outlined on the opposite page. But even this reduced expense can be avoided and the need for building up practically eliminated by the operation of HEAT TREATING rail ends. For heat treated rail ends are harder, tougher and better able to resist wear and pounding. Avoid batter in new rails by using the AIRCOWELDING process of HEAT TREATING the rail ends. It makes them good for the life of the rails.

Ends that are slightly battered, can be re-formed and then heat treated as the illustrations show. Ends that have reached the stage where building up is necessary, should be heat treated after rebuilding—and they will not have to be built up again. In short, *a sizable, chunk can be chopped off rail maintenance expense if every rail end is heat treated.*

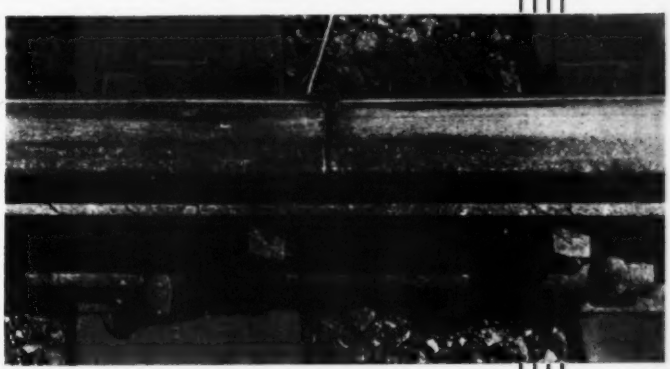
AIRCO'S RAILROAD DEPARTMENT will be glad to cooperate with Maintenance of Way Departments in putting into practice this money saving process of re-forming and HEAT TREATING rail ends.



Close-up of the re-formed and heat-treated ends. Time (for both operations) 5½ minutes. Cost, approximately 35c



Here are the ends after re-forming and heat treating. Tools used in re-forming are shown



These rails are slightly battered but they were re-formed without welding, and no adding material was required

AIRCO DAVIS-BOURNONVILLE

SALES COMPANY

District Offices and Distributing Stations in Principal Cities

ING and CUTTING SUPPLY SERVICE

· WELDING and CUTTING APPARATUS and SUPPLIES
· WILSON ARC WELDING MACHINES

Weeds in 60-90 Days Budgets Made Now Pay Best

We have repeatedly noted the improved results which accrue to those railroads that are permitted to anticipate and plan their weeding program well ahead of the season.

We have all learned the value of more thoughtful planning during these depression years.

We, as weed killing contractors, should have the opportunity to inspect the track conditions and plan the work before the work is started.

These track inspections allow us to recommend carefully computed treatments and then check the results.

ATLAS WEED-KILLERS

Weeding with Chemicals Is a Science

It is not merely the mechanical use of chemicals and sprayers. We hope the old reckless days are gone forever. The contracts were entered into by both parties without sufficient information on either side. The railroads and the contractors must know more of each other's conditions and plans.

The prices and costs must be based on results and not on trading conditions.

The Chipman Chemical Company pledges itself to good workmanship and the best of materials. The railroads can help us materially by allowing time for examination of track conditions and planning of this important work.

Chipman Chemical Company, Inc.

Bound Brook, N. J.

Chicago, Ill. Winnipeg, Canada Kansas City, Mo.
Palo Alto, Cal. Houston, Tex. London, England

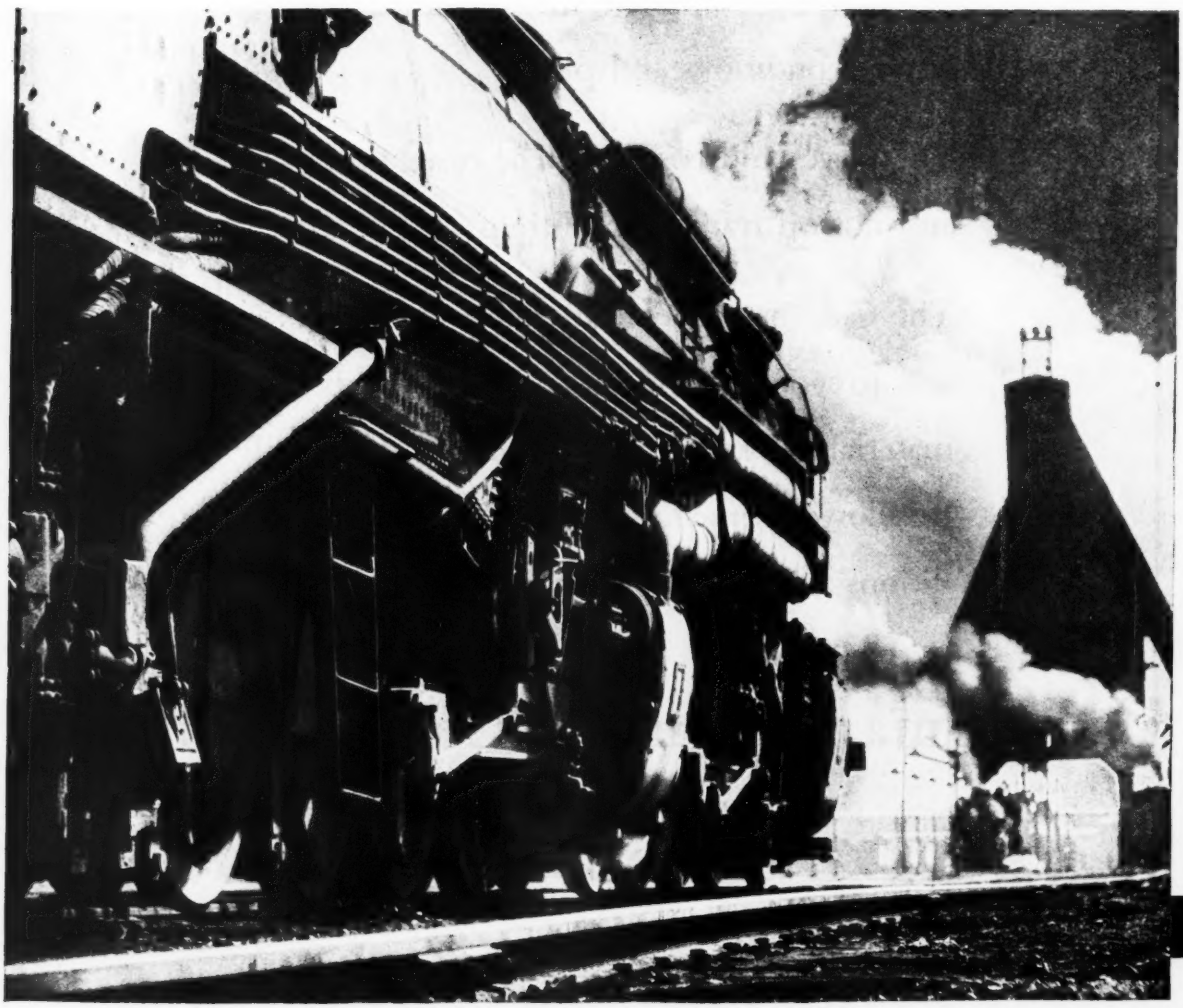
Are You Preparing a New M

★ In spite of excellent management most railroads have fallen behind on their maintenance work.

★ Present increase in rail traffic and future outlook make adequate maintenance necessary.

It is evident that, even after making full allowance for the decreased traffic, there is a deficiency of at least a full year's normal maintenance work. Time plays havoc with bridges, buildings, road beds, ties, etc., that do not receive adequate maintenance.

With car loadings showing substantial improvement and future prospects looking brighter, many railroads are giving more attention to maintenance. The first available money, in many cases, has been directed toward the smaller necessary maintenance work.



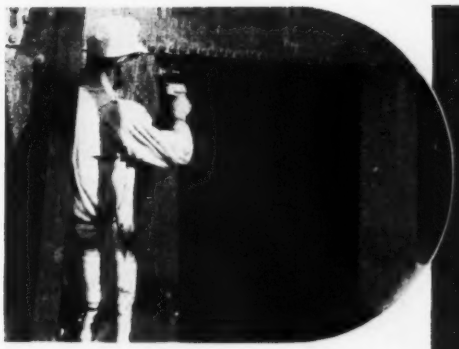
Maintenance Program?

Insure Good Maintenance With Standard Asphalt Products

RAILROADS have many uses for asphalt in their maintenance work. In planning for the necessary following maintenance, you'll find Standard Asphalt Products of the correct kind and grade to meet your requirements:

Roofing; waterproofing; protective coating for rails, and other equipment; bridge construction; insulating electric signal equipment; insulating refrigerator cars; sealing storage batteries; paving grade crossings, team tracks, and station platforms. Asphalt oils for laying dust and weed extermination. Wood preserving oil for treating cross ties, bridge timbers.

Stanolind Asphalt Products develop best results for all uses.



Liquid Coating Asphalt is used for coating roofs, steel and iron tanks, and masonry of all types.

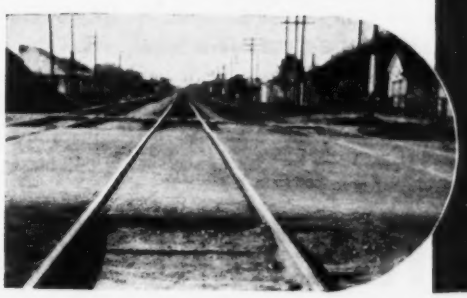
Standard Asphalt Road Oil applied to the road bed eliminates dust, protects equipment and road bed from wear and corrosion.

Tie Treating Oil helps to extend the life of ties, bridge timbers, piles, etc.

Liquid Asphalt Rail Coating prevents corrosion to rails and bolts and increases life of spikes, anchors and tie plates.

No. 1 Korite has a wide application for water proofing, for filling cracks, making expansion joints and for refrigerator car and electric insulation.

Stanolind Cut Back Asphalt and aggregate properly mixed and laid, provide excellent wearing and economical grade crossings.



STANDARD OIL COMPANY
(INDIANA)
910 South Michigan Avenue Chicago, Illinois

132-B

"Spotting"

calls for *FAST SWITCHING*

STORE-DOOR collection and delivery service certainly keeps the yard gang on the jump. Only by fast sorting, routing and train make-up can the carriers maintain this service. Spotting cars these days calls for a sure eye, a quick hand on the switch lever and a fast-operating switch stand.

That's one point you can be certain of in a Bethlehem Model 1222 Switch Stand. It's fast. A weighted lever makes it easy to operate the heaviest switch.

This stand gives the switchman the greatest amount of leverage when he needs it most—at the opening and at the closing of the switch. During the movement of the switch, the momentum of the weighted lever practically carries the switch with it, giving a fast throw-over and helping the switchman to close the switch with a minimum of effort.

You can't put a safer stand in your yard than the Bethlehem Model 1222. This stand is lower than the top of the rail, free from the danger of dragging equipment, and out of reach of the feet and clothing of men standing on the bottom rung of car ladders. Further, the throwing lever operates parallel to the track, which means that the switchman can keep his eye on approaching cars while throwing the switch.

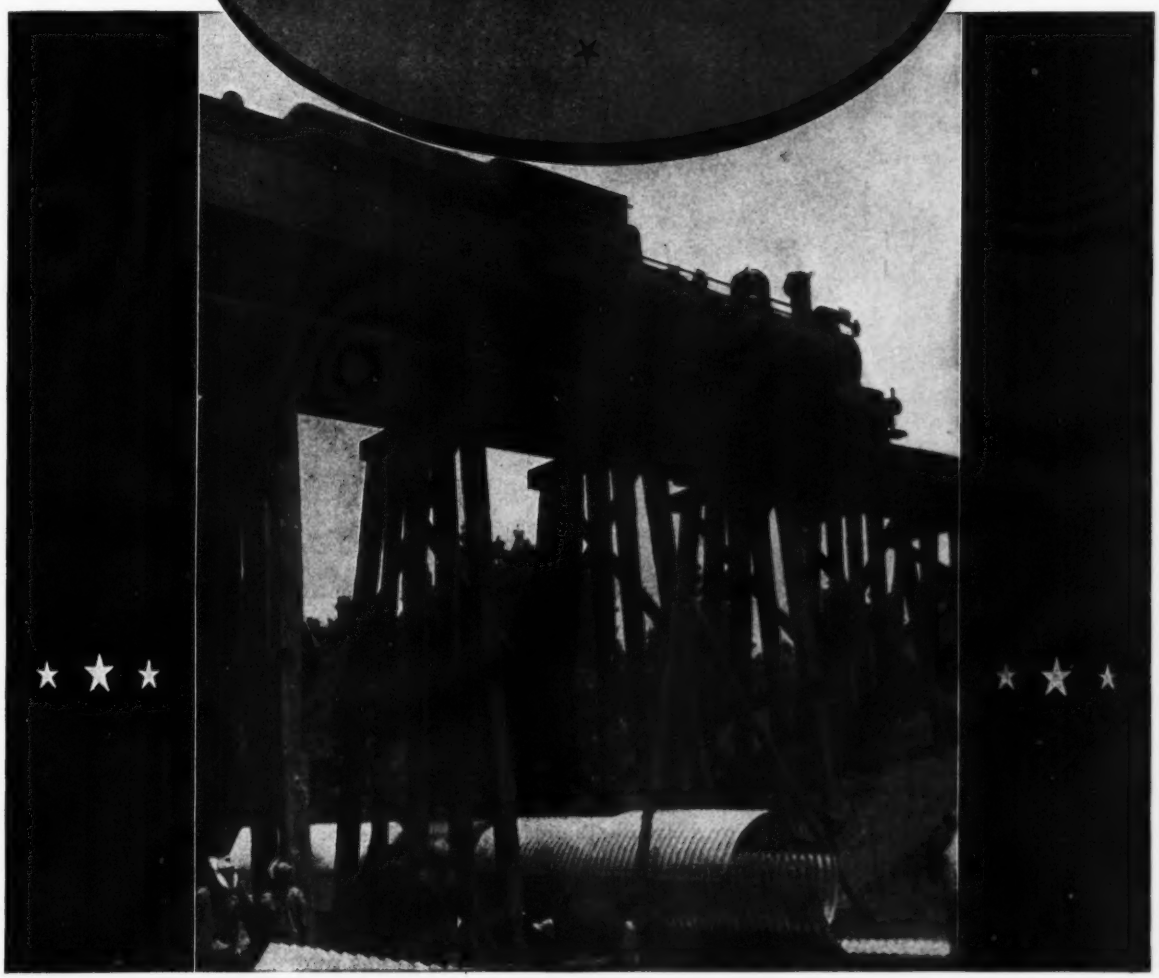
The Bethlehem Model 1222 Switch Stand has a heavy, two-tie base, and a forged-steel, adjustable screw-eye crank, giving full adjustment for any throw of the switch from 3½ in. to 6 in.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

BETHLEHEM *Model 1222* SWITCH STAND

Drainage Replacements are Easy *with* ARMCO MULTI PLATE



The last rebuilding cost—this 35-foot high timber trestle was replaced with 100 ft. of 90-in. heavy duty Armco Multi Plate Pipe.

CALL IN AN **ARMCO ENGINEER**

When your trestles, boxes and other large drainage structures need replacing, consider the simplicity, economy and low maintenance cost of super-strength Armco MULTI PLATE.

Whether you need a giant pipe or arch, it can be put in quickly by unskilled labor. And it's sure to last a lifetime!

Let an Armco drainage engineer bring you complete data applying to your own problems.

ARMCO MULTI PLATE PIPE AND ARCHES

INGOT IRON RAILWAY PRODUCTS COMPANY

Middletown, Ohio • Berkeley, Calif.
(Member of the Armco Culvert Mfrs. Assn.)

Philadelphia St. Louis Salt Lake City Los Angeles Minneapolis Houston
Portland Atlanta Denver Chicago Dallas El Paso Spokane

MOLES

Clean Ballast Without Obstructing Tracks

Moles, in Addition to Cleaning Ballast Without Train Interference, Clean at the Lowest Unit Cost

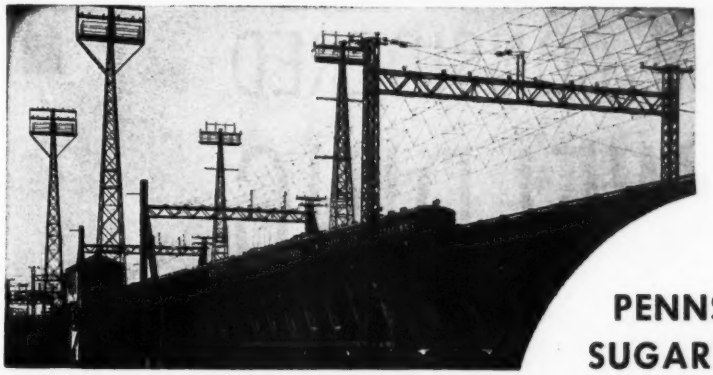
The Erie Railroad during the season of 1933 operated 15 Moles on Shoulder and Inter-Track ballast. Material in cribs between ties being removed by hand and cast to the shoulder and inter-track space.

Handling this extra yardage, the fifteen Moles averaged 20.1 miles each, at a cost (for labor, fuel, lubrication and running repairs) of 0.0233 per lineal foot for inter-track ballast and 0.0213 for shoulder.

The machines averaged 100.21 feet per hour in the inter-track and 101.18 on the shoulder.

RAILWAY MAINTENANCE CORPORATION

Pittsburgh, Pa.



PENNSYLVANIA SUGAR COMPANY

painted char house steel

10 YEARS AGO

...RED-LEAD SURFACES *still in satisfactory condition!*

HERE'S the way the Pennsylvania Sugar Company feels about Dutch Boy Red-Lead.

In a letter dated November 2nd, engineer Dan Gutleben writes: "We have not used the Saucer Test*, which you sent us several months ago, because we have been using Dutch Boy Red-Lead for so many years that we decided there was no use wasting any time on tests.

"Ten years ago we painted our char house steel, using two coats of red-lead and pure boiled linseed oil, followed by a "lead" finishing coat. In 1931 we repaired the paint on two floors, while the rest is still in satisfactory condition."

A method of trying before buying

The Saucer Test mentioned above is an easy way to prove what paint gives iron and steel structures the most durable and economical protection.

The Saucer Test Kit comes to you free . . . just send coupon below. Includes metal saucer and sample of Dutch Boy Red-Lead to test against any other paint you wish. Choose your own conditions. Test under sun, heat, cold, moisture, smoke, fumes, salt air, water.

In a long series of tests conducted by a leading Southern railroad, the Saucer Test proved that pure red-lead far outlasted other paints tested.

But don't take our word for it or the word of others. Put red-lead *on the spot* yourself. Send for the KIT and see the evidence with your own two eyes . . . how pure red-lead gives greatest protection and saves money.

DUTCH BOY **RED-LEAD**

Dutch Boy Red-Lead is a fine, highly oxidized red-lead supplied in two forms—paste and liquid. The paste comes in natural orange-red, is readily mixed to brushing consistency, and can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) is available in the natural orange-red, two shades of brown, also in black.

NATIONAL LEAD COMPANY

111 Broadway, New York; 116 Oak St., Buffalo; 900 West 18th St., Chicago; 659 Freeman Ave., Cincinnati; 820 West Superior Ave., Cleveland; 722 Chestnut St., St. Louis; 2240 24th St., San Francisco; National-Boston Lead Co., 800 Albany St., Boston; National Lead & Oil Co. of Pa., 316 4th Ave., Pittsburgh; John T. Lewis & Bros. Co., Philadelphia.

NATIONAL LEAD COMPANY
Please send *free* kit for making the "Saucer Test."

REM-3-34

Individual's name and title.....

Firm name.....

Street.....

City..... *State*.....

HAVE YOU CONSIDERED ARC WELDING IN YOUR 1934 MAINTENANCE PROGRAM?

Railroads were among the pioneer users of arc welding, because this new process gave them an efficient, economical, and satisfactory method of repairing worn equipment and quickly putting it back into service.

The demonstrated economy of arc welding as a repair tool has led to its adoption for other railroad-maintenance work. Arc welding offers an opportunity for positive savings in track repair, including the building-up of battered rail ends and worn crossings and frogs, and the repair and strengthening of bridges and buildings.

General Electric, always a leader in the development of arc-welding equipment, has introduced a complete line of products to handle these new applications. Gas-engine-driven sets with flanged wheels and special derailing features, and tractor and tank types of mobile welders can be furnished for any maintenance problem. Included in the complete line of G-E welding electrodes are new types having characteristics especially suited to track-maintenance work and the fabrication and repair of steel structures.

We suggest that, when you plan your 1934 maintenance program, you investigate the complete General Electric welding service for railroads. General Electric can supply everything you need for arc welding.

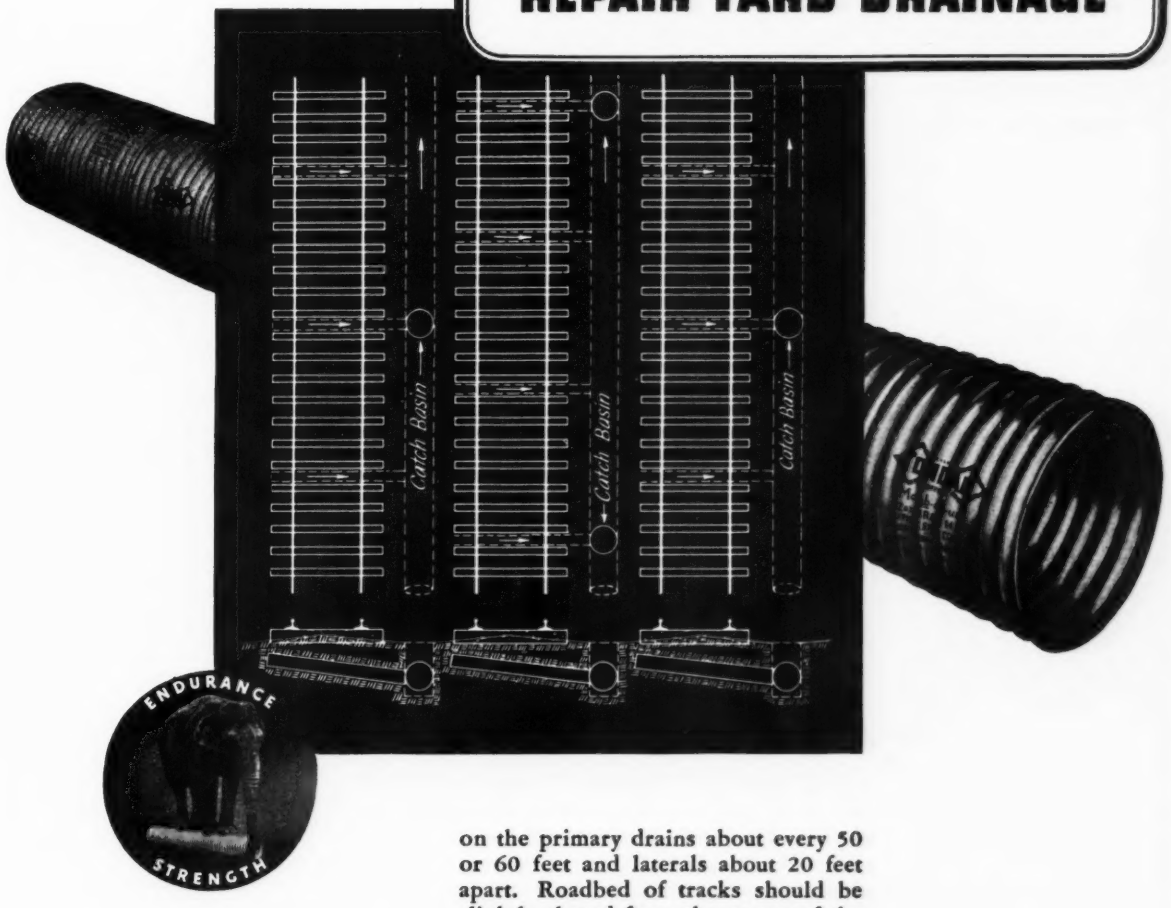
ARC WELDERS • WELDING ELECTRODES
WELDING ACCESSORIES • APPLICATION SERVICE

For information on all G-E welding equipment or G-E welding application service, address your request to the nearest G-E sales office, or Department 6A-201, Schenectady, N. Y.

140-5

GENERAL ELECTRIC

TONCAN IRON CULVERTS FOR CAR REPAIR YARD DRAINAGE



Car repair yards usually have a number of tracks with wide track centers where cars are placed and given repairs or almost completely rebuilt. As the grades on these tracks are in most cases level in order to allow the cars to be moved without a locomotive, drainage becomes a problem after each rain storm, making disagreeable conditions for workmen.

As the track centers are wide, the problem can best be solved by placing perforated culverts between each of the tracks as primary drains leading to the outlet drain, and by running laterals as secondary drains from each track. Catch basins should be placed on the primary drains about every 50 or 60 feet and laterals about 20 feet apart. Roadbed of tracks should be slightly sloped from the center of the tracks to the primary drains. Back-fill all trenches with crushed stone, good, clean cinders, or slag.

When designing car repair yard drainage, it's a good idea to look ahead and specify a culvert material that will more than justify its slightly higher cost by the additional years of service it will give. Toncan Iron will always do that, because its alloy structure of refined iron, copper and molybdenum has been proved more rust-resistant than any other ferrous metal, except the stainless alloys. Specify it by name and look for the Toncan Iron trade mark on every length.

TONCAN CULVERT RAILWAY SALES
310 South Michigan Avenue
Chicago, Illinois

TONCAN
COPPER MO-LYB-DEN-UM
IRON CULVERTS

TONCAN CULVERT MANUFACTURERS' ASSOCIATION • YOUNGSTOWN, OHIO

No. 63 of a series

Railway
Engineering and Maintenance

SIMMONS-BOARDMAN PUBLISHING COMPANY

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Results from Advertising

February 22, 1934.

Dear Reader:

I have told you in earlier letters that the $2.00 that you send us in payment for your subscription to Railway Engineering and Maintenance (or $3.00 if you subscribe for two years), pays only a fraction of the cost of producing your magazine and that the remainder of the cost is defrayed from income that we receive from advertising. It is only natural, therefore, that a manufacturer who makes the expenditure necessary to bring his sales message to you from month to month through our advertising pages should welcome evidence of the fact that you read his advertisements and find them helpful.

By reason of the complicated nature of the railway organization, a requisition or a request for a product must pass through the hands of numerous officers and be approved by each of them before it reaches a manufacturer in the form of an order. Because of this fact, it has long been recognized by experienced railway manufacturers that results traceable directly to advertising are rare but must be measured rather by the trend in total sales volume.

For this reason, when going over a prominent western railroad with the chief maintenance officer a few days ago, I was especially interested when he volunteered the statement that "after reading the advertisement of the ..... Company in your November issue, I asked our people to see that this device was specified on the next order that we placed. This was the first information that I had seen regarding it."

I am sure that if you appreciated how helpful information of this character is to those manufacturers whose patronage makes this magazine possible, you would tell them and us about such experiences more frequently than you now do.

Yours sincerely,

Elmer T. Howson

ETH*JC

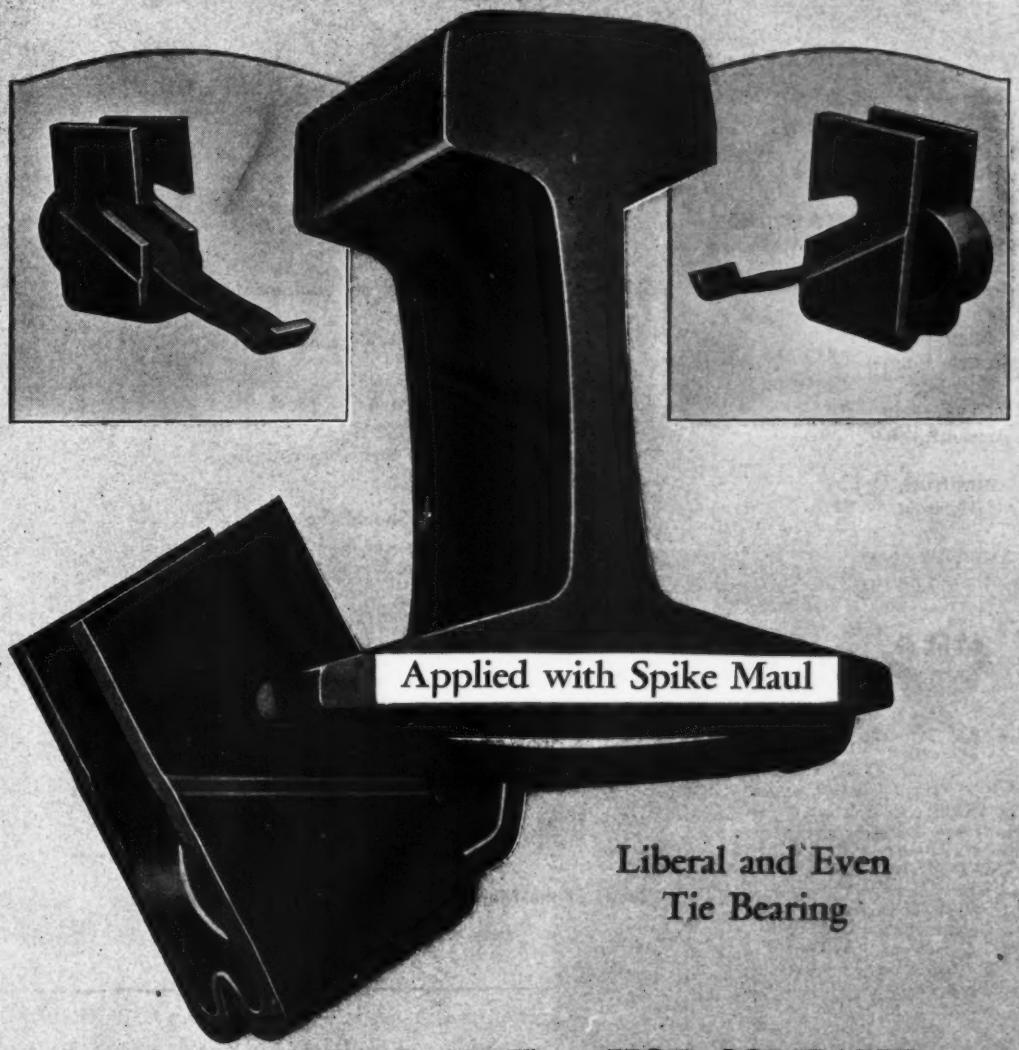
Editor

MEMBER: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

"STEAD"
TRUE TEMPER RAIL ANCHOR

Clamp and key are now shipped assembled which facilitates handling and simplifies application.

Initial and Application Costs Low



THE AMERICAN FORK & HOE COMPANY

General Offices: Cleveland, O. *Factory:* North Girard, Pa.

District Offices

253 Broadway, New York, N. Y.—Daily News Bldg., Chicago, Ill.

Representatives at

Boston, Denver, Detroit, Minneapolis, St. Louis and San Francisco

Foreign Representatives

Wonham, Inc., 44 Whitehall St., New York, N. Y., and 68-72 Windsor House, Victoria St., London, S.W.-1

Published on the last Thursday preceding the month of issue by the

SIMMONS - BOARDMAN PUBLISHING COMPANY

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30 Church Street

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Terminal Tower

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17 and H Streets, N. W.

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Railway Engineering and Maintenance

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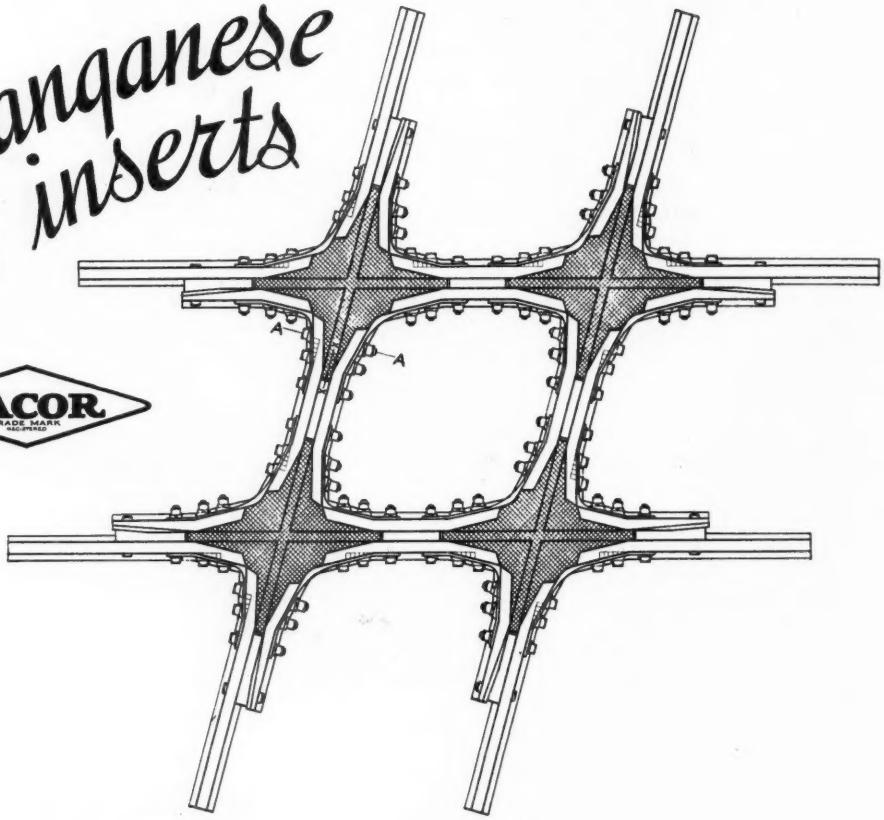

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Railway Engineering and Maintenance

REGULATION

Should be Applied Alike to all Competitors

EVERY employee of a railway is vitally interested in the efforts that are now being made to establish equality of competition between the railways and those other transportation agencies that are seeking to divert traffic from the railways—especially the highway carriers. It is essential, therefore, that railway employees understand the conditions which now prevail and which it is sought to correct.

It is recognized by all fair minded persons that equality of opportunity is essential to fair competition. This is an axiom of American business. No industry can either prosper or render its full measure of service to the public when it is shackled in meeting the inroads of competitors. Rather, it is in the public interest that all agencies be placed on a basis of equality, so far as regulation or restraint is concerned, in order that the public may derive the full advantage of each service. Does such equality prevail between railway and highway carriers today? As a political leader has said so pointedly on numerous occasions, let us look at the record.

Regulation is Established Policy

In the first place, it has become the established policy of this country to supervise and regulate the activities of the railways in many directions. This policy has been predicated on the ground that it is in the public interest. As it has been developed, it has ramified in many directions—rates, standards of service, competitive practices, wages, working conditions, safety, etc., each tending to circumscribe the railways and restrict their initiative. If such control of the railways is in the public interest, and this is not questioned here, it would appear equally desirable and necessary to regulate the corresponding activities of those other agencies that seek to serve the public in the same manner. This is the objective of legislation recently introduced in Congress and in the legislatures of several states. That this proposed legislation is being attacked by those agencies whose activities it proposes to control does not detract from its need.

Service and Rates

The public is interested first of all in character of service. So far as the railways are concerned, the standards of service are subjected to close supervision. Cars of the proper character must be provided shippers as requested—schedules must be maintained, etc. In many states, railways cannot take off trains without the consent of the railway commission, and then frequently only after public hearings. Highway carriers, on the other hand, operate at will, with no compulsory continuity of service, annulling or changing schedules as they desire and without notice. In other words, they are free to serve their own interests without regard to the interest or convenience of the public.

Stability Essential

Take the question of rates. Stability of rates is essential to the orderly conduct of business. Secret rebates or other rate-cutting practices introduce an element of uncertainty into commercial business that promotes chaos. It was for this reason that railway rebating was prohibited by law years ago. As a result, every business man not only knows now what his cost of transportation by rail will be, but he also knows what his competitor must pay because all rail rates are public. This is recognized to be in the public interest. Yet, no such protection is afforded the user of highway transportation. There is no stability of rates, but each transaction is a question of barter. No patron knows that his competitor is not securing a lower rate or that he can himself secure the same rate on the following day or week.

Taxes

Again, consider the matter of taxes. The railways provide and maintain their roadways; they also provide protection where their traffic crosses important highways. In addition, in 1933 they contributed 8.06 cents from each dollar received, for the support of government, local, state and national. In many areas, these taxes constitute the major support for the public schools, the school taxes paid by the railways being estimated to provide schooling for approximately 1,650,000 pupils.

Commercial highway operators, on the other hand, pay a much smaller proportion of their operating revenue (5.9 cents for seven states where figures for commercial operators were available in 1931) for taxes and fees, including gasoline taxes, revenue and income taxes, license fees, etc. But are these taxes in the commonly accepted use of the word? In the first place, they include the tax on gasoline which is paid by private car owner and commercial vehicle operator—alike—a rental for the use of the highway and designed to pay its upkeep and

possibly amortize a part of the first cost. License fees are charges of the same character and for the same purpose. If these are deducted, there are left only property taxes and income and revenue taxes, the total of which is small. In other words, the contribution made by highway operators to the support of the public schools and other agencies of government is almost negligible.

Furthermore, these highway carriers oppose most bitterly every attempt to divert gasoline or license taxes to the support of government. It is pertinent to note that if to the taxes now being paid by the railways, there be added the additional amounts spent by them for the maintenance of their roadways, for interest on the investment in their roadways and for grade crossing protection, their total payments for these purposes would approximate 30 cents per dollar of gross income, as compared with the 5.9 cents noted above for the highway operators.

Regulation of Labor

Another effect of governmental regulation deals directly with labor. It has been considered to be in the public interest to limit the hours a railway employee may work. It has likewise been deemed advisable to insure that railway employees be adequately paid, hence the federal wage boards. As a result, a locomotive engineer on a branch line run of 100 miles now receives at least $150 per month of 26 days, working probably 90 to 100 hours, while under the new N.R.A. code a bus driver receives from $52 to $65 per month for 208 hours of labor. In other words, he works more than twice as many hours for slightly more than one-third the wages of the engineman.

It has likewise been found to be in the public interest to regulate the railways with respect to safety. Despite the fact that trains run over private rights of way, generally enclosed by fences, are protected by automatic signals and with the grades separated at the most important crossings with highways, the government, through the Interstate Commerce Commission, maintains a large staff of inspectors to detect and correct any condition which is found to be unsafe in any detail. Likewise accidents are investigated and additional regulations adopted as they appear necessary. If such regulation is necessary for equipment that is built to such rigid standards and operated by men of such long experience and intensive training, how much more necessary is it for highway equipment, individually owned and maintained without expert inspection and care.

Same Regulation Justified

Such are the regulations that have been imposed on the railways—regulations that seriously limit their freedom of action and add to their operating costs. If such regulation of the railways is in the interest of the public, and few seriously question this fact today, it would appear to be equally necessary over those agencies which seek to render the same service. This is the purpose of legislation now being promoted in Congress and in several state legislatures. It should receive the hearty support of every railway employee, directly with his representatives in the national and state legislatures, and indirectly with those persons with whom he comes in contact who may be encouraged to give similar endorsement.

TRESTLES

A Revolution in Construction Practice

THE application of mechanical equipment to roadway operations has had its greatest development in out-of-face work, which has a counterpart in the maintenance of structures only in the complete renewal of bridges and possibly a few other operations, such as painting. The pneumatic riveter, the cutting torch, the power drill and modern hoisting equipment have long had extended application in the construction and renewals of metal bridges, while fusion welding is finding an important place in the strengthening and repair of such structures. But the application of power appliances, other than the pile driver, to work on wooden pile trestles has proceeded at a much slower rate. Considerable development has taken place in this field during the last four years, but in the meantime measures to increase the life of treated wooden trestles is effecting such a revolution in practice as to comprise one of the most interesting developments in maintenance of way work.

About a decade ago, a few roads started to preframe the ties and guard timbers for the decks of steel bridges. Because this necessarily entailed the taking of close measurements, the preparation of detailed plans, and more involved bills of material, it was deemed by many as altogether too complex a procedure for practical application. But experience proved the contrary; the practice spread to other roads, and was later applied also to creosoted pile trestles. However, in the adaptation of preframing to these latter structures certain obstacles were encountered, because standard plans for trestles that had been developed long before preframing was thought of made it difficult to avoid some cutting of timbers in the field. This led eventually to the complete redesign of standard trestles to insure a minimum of fixed dimensions that make for complications in preframing. In a word, pile trestle construction, at least in-so-far as it relates to trestles of treated wood, is rapidly approaching the status of steel bridge work, namely, the fabrication of members in the shop to a degree of accuracy that reduces field work to a matter of erection.

In these circumstances, the primary demand for machinery—at least for wood cutting and boring tools—will come from the shop, where most of the machine work will be done. But this will in no way reduce the need for maximum economy in erection, which means that every effort should be made to develop a maximum use of suitable power cranes. And as erection is speeded up, there will be a definite need for power saws and drills, to avoid delays incident to the use of hand tools in such emergency cutting as will be required. Furthermore, power cutting tools have an important place in the expeditious removal of the structures being replaced.

This development is still in its infancy. Its proponents have had to meet prejudice born of long established trade practice every step of the way. Because wood can be cut so easily in every stage of its application to a structure, it has been exceedingly difficult to convince carpenters that this should not be done indiscriminately, even if this obviates the need for painstaking measurements. But just as it has been difficult to effect the transition from "cutting to fit" to "cutting to measure," so also will it require intensive study before the last

word has been said on the best practice in trestle construction under the new order of procedure.

All of this goes to prove that precedent means little in these days. The merits of an innovation cannot be judged accurately if the study proceeds on the assumption that some of the conditions under which it is to be applied must remain fixed. More progress is made by fitting the organization and procedure to the idea, than by attempting to modify the idea to fit the established order under which it must work.

MORE WORK

Will Create Increased Demand for Equipment

THE use of power equipment in maintenance of way work is now so general that one is prone to forget that this development has occurred within a period of only about 20 years. Any one whose experience goes back over these two decades will recall how few mechanical appliances were in use at the opening of the world war. Furthermore, his recollections of the initial efforts of the proponents of pioneer appliances will stir feelings of admiration for the courage and persistence with which they fought to obtain consideration in an unresponsive market. It is true that some maintenance of way officers manifested real enthusiasm from the beginning for the appliances that were offered, but many of them evinced extreme conservatism and still more were reluctant to recommend the purchase of equipment to their managements. The most common objection offered was that the machine might be all right for the "rich" road but that it was out of the question for a road of moderate earnings.

Time has wrought pronounced changes in this point of view. It has been found by experience that the first cost of even some of the larger and more expensive machines ceases to present a serious problem, because they will save enough money in the cost of performing the work for which they are designed to wipe out the cost of acquisition in a short time, provided they are kept busy. Thus, ownership of power equipment has become less a matter of ability to buy than of having enough work for the machine to do. Obviously the heavy traffic lines have always presented greater opportunity for the profitable operation of power equipment, but reorganization of forces and well-considered plans for the scheduling of work have overcome most of the obstacles to mechanized operation on those railroads of lighter traffic.

However, regardless of the relative amount of work done by different roads, the need for new machinery decreases when the general scope of activities falls off markedly. This is what has occurred during the last four years. The railways decreased their buying of power appliances during this period more largely because they had a surplus of machines than because they were too poor to buy them. Proof of this statement is to be found in the fact that they did buy some appliances that could do more or better work than machines they already owned.

This, then, determines the basis for decisions regarding the purchase of power equipment in the immediate future. The need for additional equipment will be measured primarily by the savings that can be effected in performing the work to be done—either by substituting mechanical for manual methods or by replacing old or obsolete equipment with newer and more efficient units. With the large amount of work now to be done and with the certainty that the allowances available, even though increased materially over those of the last two or three years, will be entirely inadequate to complete all of this work, it is self-evident that the demand now is for maximum efficiency in order that such money as is available will render the maximum service. This should be a year, therefore, of greatly increased use of mechanical equipment in maintenance of way work.

QUALITY TOOLS

Are Related Directly to Labor Economics

THAT local maintenance officers prefer good tools for their forces is well known. It is equally well known that foremen and workmen alike are extremely desirous of using tools of demonstrated merit. The extent to which these preferences are shared by officers of higher rank in the maintenance of way department has sometimes been questioned. The workman wants quality tools because they make his work easier and because he knows that he can do better work with them. The foreman wants them because he is judged by the quality as well as the quantity of work that is turned out by his gang, and by the morale he is able to maintain among his men. The supervisor prefers them for the same reasons, besides which the matter of repairing the tools is simplified. In other words, the men most closely associated with the use of tools have learned from experience that there is an improvement in the output of their men, in the quality of the work they produce, in the morale that is maintained and, often, in the number of accidents that occur, where quality tools are provided, as compared with these factors when they are required to use tools of poor quality.

Most of the officers of higher rank in this department are aware of this preference for high-grade tools on the part of the local forces, but being less closely in touch with the details of their use, do not always recognize the full significance of the preference that is displayed by those who use them.

If they were to investigate the subject of quality in tools and the effect produced by differences in quality, many of them would be greatly surprised by the information that would be developed. In other words, if they do this, they will find that tools are a far more important factor in the economies that can be attained in the work of this department than is generally realized. In an article on a following page maintenance officers, from foremen to chief engineers, testify to the direct relation between the quality of tools and both the output and the quality of the work of their forces. Since these statements are based on experience, they demonstrate that the whole subject of quality in tools is worthy of more serious study than it has received.

What Is Ahead?

What of the need for greater expenditures for the maintenance of tracks, structures and other fixed properties?

WHAT is ahead in maintenance of way and structures? Are the roadway and structures undermaintained today and if so to what extent? Where are the deficiencies most evident? Will the railways spend more money in 1934 than they did in 1932 and 1933? What classes of work will receive first attention? Are capital expenditures to be resumed?

These questions are uppermost in the minds of maintenance of way officers. They are also of direct concern to the manufacturers of materials and equipment employed in the maintenance of the roadway and other fixed properties of the railways. Of most immediate concern are the nature and extent of the deficiencies in upkeep that are in most urgent need of correction, and the magnitude of the programs that will be carried out in meeting these needs during 1934. But aside from these problems of the immediate present, every maintenance officer has an intense interest in the amount of deferred maintenance in the aggregate and this interest is by no means entirely academic, for deferred maintenance presents many practical implications.

A comparison of the applicant's figures for tons of new rail used in replacement per thousand gross ton-miles, for 1923 to 1929 with those for the years 1930 to 1932, indicates an average annual decrease for the system during the latter period of approximately 30,000 tons, making a total of 90,000 tons for the period, or more than four times the amount of new rail proposed to be laid.

From I. C. C. decision of January 12, 1934, approving application of Illinois Central for a federal loan for 21,600 tons of rail.

In so far as 1934 is concerned, every evidence points to expanded activity. Earnings have improved steadily since the spring of 1933. Carloadings, the advance index of earnings, continue to show improvement. But more specific than this, expenditures for maintenance of way began to increase as far back as July, 1933, and exceeded those of the corresponding month of the previous year in every month since that time. The total excess for the second six months of 1933 over the expenditures for the second half of 1932 was $12,129,000. Furthermore, the railways have definitely signified their intention to expand their maintenance of way operations in 1934—they are ordering increased tonnages of rail and they are availing themselves of the opportunity to secure financial aid from the federal government.

One point to be considered in any study of this subject is the profound need for greatly expanded operations. An analysis of the expenditures of the Class I railways for maintenance of way and structures during the last four years, in comparison with those for the previous five years, indicates a net deficiency of about $700,000,000 in the expenditures for roadway, bridges and other fixed properties since 1929. This is an enormous sum—so large that it must not be assumed that the deficiencies in the outlays on various elements of the fixed properties which it embraces must or can be made good in one, two or even three years.

In making any analysis of the amount of deferred maintenance prevailing today, one is confronted with the necessity of determining a basis from which to start. Were the standards that prevailed in 1929 excessively high or were they warranted by the economies they produced? In comparing the expenditures of the last four years with the outlays for the five earlier years, it is, of course, necessary to make adjustments for the heavier operating charges incident to the extensive additions and betterments projects carried on prior to 1930, and in like manner, to take due account of the influence of decreased "use" during the last four years. It is questionable whether the effects of reductions in prices and of possible increases in the efficiency of labor should be considered because of the intangible nature of these items. Furthermore, these influences have been offset in part by other factors that have likewise been ignored—for example, the greater cost of making good deferred maintenance, by reason of the well known fact that it is cheaper to keep physical elements in a fixed state of repair than to restore them to this condition after a period of progressive deterioration.

The annual tie renewals for the years 1922 to 1929, and for the years 1930 to 1932, both inclusive, averaged 4,385,515 and 2,532,121 ties, respectively. If consideration be given to the decreased use of the applicant's railroad, it appears that the average annual renewals for the latter period would have necessitated the yearly insertion of 4,314,198 ties, while, as shown above, an average of only 2,532,121 ties were inserted, creating an annual shortage of 1,782,077 ties, and a total for the period of approximately 5,350,000 ties.

From I. C. C. decision of February 9, 1934, approving application of Southern Pacific for a federal loan for 1,820,000 ties.

In support of the contention that the expenditures in the years prior to 1930, with suitable adjustments as outlined above, should be used as the basis for compari-

son, attention is directed to the fact that this is the basis employed by the railways to demonstrate their requirements for new rail in their application for loans from the $51,000,000 P.W.A. fund set aside to finance the purchase of rails and track accessories. Those who oppose this basis contend that current deficiencies in the upkeep of fixed properties should not be based on a comparison with their condition in 1929, but upon the expenditures necessary to meet the requirements imposed by the current volume of traffic or by that to be expected in the months immediately ahead. In support of this position, it is pointed out that the drastic reduction in expenditures for maintenance has as yet resulted in little evidence of decrease in the effectiveness of the fixed properties. Attention is directed also to the fact that the decade ending with December 31, 1929, was a period of intensive improvement of tracks, bridges, buildings, terminals and water supply facilities, and that much of the reduction in expenditures made since that date is but a return on the investment in facilities that can be maintained for less money.

The applicant states that during the period 1922-1929, inclusive, an average of 24,903 tons of new rail was laid in replacement in each year, while for the period 1930-1933, inclusive, the amount laid annually was 6,887 tons; and that during those periods the gross ton-miles of freight averaged 9,400,000,000 and 7,800,000,000 respectively, a decrease of 17 per cent for the latter period. If the foregoing figures be used as a basis and effect be given to this decrease in traffic, the replacement that would be required to bring the average for the latter period up to that of the former period would be 13,783 tons for each year, or a total of 55,132 tons for the four year period.

From I. C. C. decision of January 17, 1934, approving application of New York, New Haven & Hartford for federal loan for 10,000 tons of rails.

Tie Renewals Must Be Increased

There is, after all, no direct conflict between these two positions. The first is based on the assumption that the physical condition of the railways in 1929 was founded on the dictates of ultimate economy in maintenance; the second is predicated on the requirements for safe and effective train operation. This may be illustrated by a study of tie renewals on eight railways, with about 31,000 miles of tracks, for which complete data are available. In 1911, these railways renewed 233 crossties per mile of track, while in 1929, they renewed only 124. If it is to be assumed that the average renewal requirements, by reason of measures to increase the life of ties, continued to decrease at the same rate during the following years, the average requirements during the four years, 1930-33, would have been about 112 ties per mile per year, and this is surely as low a figure as it would be safe to use. However, the actual renewals during the four years averaged about 65 ties per annum, thus indicating an accumulated deficiency of about 195 ties per mile, which, together with renewal requirements of, say, 100 ties in 1934 means that there are now in the tracks of these roads an average of about 300 ties per mile that possess less than one year of additional life, as compared with only 124 ties per mile in this condition in 1929.

However, inasmuch as renewal requirements of 300 ties per mile per year were the rule rather than the exception in tracks of the highest standards only a few years ago, the present average tie condition on these eight railways is in no sense alarming, although it is obvious that henceforth tie renewals on these roads must be made in increasing numbers—at least 100 ties per mile per year—to avoid a further reduction in the average tie condition. Attention should be directed also to the fact that the eight railways used in this illustration include those that have been among the most progressive in the adoption of practices designed to obtain the greatest service life from the ties that they have applied.

Still one other point may well be raised with respect to this illustration. The conclusion reached with respect to the current deficiency in tie renewals on these eight railways is contingent on the assumption that the rate of renewals in 1929, namely 124 ties per mile, was just sufficient to replace all ties that were not deemed serviceable, and that it was in no way wasteful or excessive. If, therefore, it was good policy to maintain a tie condition that allowed only 124 unsound ties per mile of track in 1929, instead of 200 or 300 ties per mile, there is good reason for the conclusion that tie renewals should be increased to bring the average tie condition to the point where the unserviceable ties in track will substantially equal the average annual rate at which they become unserviceable.

It appears that during the years 1922-29, inclusive, the amount of new rail laid in replacement averaged approximately 177,000 tons a year, while for the years 1930-32, inclusive, the average was about 73,000 tons. From 1929 to 1932, the applicant's freight traffic averaged about 86 per cent of that in the preceding years and, as rail wear depends largely upon the amount of traffic hauled, the yearly average of rail replacements that would be required for the period 1930-32, if based on the period 1922-29 and diminished in proportion to the decreased traffic mentioned, would be 152,468 tons, as compared with the yearly average of 177,000 tons laid during the period 1922-29. As the amount of new rail actually laid during the period 1930-32 averaged only about 73,000 tons a year, or over 79,000 tons less than what would appear to be the applicant's annual requirements during that period, the proposed maintenance appears to be fully justified.

From I. C. C. decision of February 26, 1934, on application of Pennsylvania for a federal loan for 100,000 tons of rails.

Restoring the Average Tie Condition

Based on these considerations and a study of the renewal statistics for the last 10 years, it is concluded that the volume of renewals required in 1934 and following years to avoid further depreciation in the average tie condition must be at the rate of about 65 million ties per year. However, to restore the average tie condition to a figure approaching that which prevailed in 1929, it will be necessary eventually to apply some 70 to 75

million ties over and above a minimum annual requirement of 65 million. This conclusion takes no account of the increased application during the last three years of untreated ties on certain roads that have heretofore inserted only treated ties.

The situation with respect to ties has been discussed in detail because it lends itself to analytical treatment more readily than other physical elements of the fixed properties, but much the same analysis could be applied to other items if it were possible to develop the figures. In the case of rail, with respect to which some definite figures are available, but not to the same extent as with ties, the current deficiency in renewals is estimated at 3,400,000 tons. This figure is arrived at by comparing the actual renewals in the last four years with figures for the annual requirements in those years that take into account the decrease in the volume of traffic handled, and also make allowance for the increased life of rail resulting from the adoption of measures to obtain longer service, as indicated by the downward trend of renewals in the face of increased traffic between 1925 and 1929. This process which, as stated above, has been employed by the railways in applications for P.W.A. loans, necessarily involves approximations that may be subject to question, but calculations based on any reasonable assumption will show a large deficiency in renewals. Rail renewals as well as crosstie replacements will necessarily occupy an important place in maintenance of way operations during 1934.

Has the Limit in Rail Weight Been Reached?

However, any figure for rail requirements that is based on a study of the renewals in the last 10 years will fail of any reconciliation with actual experience, for, in spite of a profound reduction in the rate of renewals, there is support for the conclusion that renewals during the present year of not to exceed a million tons will insure a track condition commensurate with the requirements of traffic. The reason for this discrepancy lies in the fact that renewals during the last three years have been predicated solely on the requirements of safe and effective operation, whereas in the decade prior to 1930 there had been a pronounced trend toward the use of heavier sections after analytical studies and the accumulated experience of several roads had demonstrated that heavier rails, as well as greater strength in other elements of the track structure, result in lower maintenance expenditures. And there is no question but that the present effectiveness of main line tracks after four years of steadily declining expenditures for maintenance has been possible only because of the trend toward heavier construction during the "twenties." The fact that tracks laid with rails weighing more than 100 lb. per yd. now total less than 45,000 miles, and that the trend of train speeds, freight as well as passenger, is steadily upward indicates that the possibilities for greater economy in track maintenance through the use of heavier rails was by no means exhausted when the program was abruptly suspended in 1929.

Ballast, Weeds and Drainage

The same observations apply with equal effectiveness to other features of the track. Improved technic in welding has increased the life of frogs, switches and crossings markedly, while improved standards of construction have had a pronounced influence on the effectiveness of repair measures. On the other hand increased train speeds impose more exacting requirements on special track-work than on any other part of the structure.

Low track maintenance expenditures during the last four years have been made possible to no small extent by the widespread attention that was given to drainage for a considerable period. This applies not only to the application of more and better ballast and to improvements in the technic of cleaning ballast but also to improvements in subsurface drainage. As an evidence of the importance now being attached to the cleaning of ballast, a large unit of one road has cleaned more ballast during the last two years than ever before, in the face of urgent demand for retrenchment. It is indicated also by the fact that measures to improve roadbed drainage have suffered less curtailment than almost any other operation incident to track maintenance. True, most of the projects carried on during the last three years have been of an emergency nature—to cure some extreme condition of roadbed instability or to effect an immediate reduction in the cost of track surfacing. However, the net result of these drainage measures has been to demonstrate still further the economies to be derived by the application of similar measures to other locations, and these, also, have a place in the program for 1934.

No discussion of drainage is complete without some reference to weed eradication, since the primary economic justification for expenditures to this end is its effectiveness in retarding the fouling of ballast. Obviously, failure to remove weeds from the roadway exerts a measurable effect on the efficiency of track from a transportation standpoint only in extreme cases. Weed eradication has therefore, been an operation that has been dispensed with in the demand for reductions in expenditures. But in view of the demonstrated economy of weed removal it is to be expected that this practice will be resumed on a scale approaching that prevailing during the "twenties."

Structures—More Renewals, Less Patching

An analysis of the expenditures for the maintenance of bridges, culverts, buildings and like structures indicates a deficiency of at least $120,000,000. As with track maintenance the repair of structures during the last four years has been confined to those items that have to do with the safety and effectiveness of the structures. This is evidenced by the fact that far greater reductions were made in expenditures for the upkeep of buildings than for the maintenance of bridges. In 1932, for example, the last year for which detailed figures are available, the expenditures for building maintenance amounted to 35.4 per cent of the average annual outlay in the five years, 1925-1929, as compared with 45.3 per cent for bridge maintenance. But even with bridges, trestles and culverts, maintenance work has been confined largely to emergency measures to insure safety, rather than to normal renewal programs. In the case of metal structures, this has given added incentive to strengthening and repair work. In the case of trestle bridges, it has led to the addition of piles, the replacement of caps, stringers, etc., and other heavy repairs beyond limits that have proved economical under normal conditions.

This policy has resulted in a damming up of a demand for heavy renewals, especially on those lines that still embody extensive lengths of untreated wooden bridges. And on those roads that had previously prosecuted programs of replacement with structures of treated wood, reinforced concrete or steel, every effort has been made to defer renewals until more favorable conditions would afford opportunities for the necessary capital outlays. The fact that bridge renewals are included among items

(Continued on page 135)

Federal Loans Stimulate Buying of Track Materials

Orders and commitments for rail of only 33 railroads total almost 600,000 tons—Others are still to be heard from

The Amount of Rail Laid in 1934 Will Far Exceed the Totals for 1932 or 1933

SINCE last October, 22 railways have ordered 344,916 tons of rails while further orders soon to be placed by 12 others will aggregate 243,382 tons. Thus, with specific figures available from only 33 roads, the laying of 588,298 tons of new rail this year is definitely assured, making no allowance for the rails to be bought by a considerable number of important properties that have not yet been heard from. It is certain, therefore, that the amount of rail laid in 1934 will far exceed the totals for either 1932 or 1933.

Of the total of 588,298 tons, the larger part, or 356,298 tons, represents the rail ordered, or soon to be ordered, by 16 roads that have been granted loans or are now negotiating loans from the federal government, out of a special fund of $51,000,000, allocated by the Public Works Administration for this purpose. After this project was set on foot by Joseph B. Eastman, federal co-ordinator of transportation, on September 8, when he invited the railroads to make tentative commitments of their needs, with the idea of pooled orders to be placed by his office, 47 railroads submitted figures for their requirements, aggregating 844,575 tons. Of these 47 roads, 10 have specific tonnages represented in negotiations for loans and 16 others have placed orders that are to be financed from corporate funds, leaving 21 roads with tentative commitments amounting to 172,000 tons, concerning whose plans further announcements have not yet been made.

Reasons for Delays

This plan for federal assistance to the railways in the improvement and upkeep of their properties, as a means of fostering re-employment and advancing business activity, is unique in American railway history. As reported in detail in *Railway Engineering and Maintenance* for November, page 538, the element of this plan having to do especially with the purchase of rails and track accessories was announced on behalf of President Roosevelt on September 8. In addition to providing for loans to the railways on 10-year promissory notes, without interest the first year and with interest at 4 per cent per annum thereafter, and for the pooling of purchases, a feature that has since been abandoned, the plan contemplated a reduction in the price from the base figure of $40 per gross ton then prevailing. The negotiations with the rail manufacturers for the purpose of obtaining a concession in price consumed more time than had been anticipated, and it was not until October 30, that the President effected a compromise between the manufacturers, who contended for a price of $37.75, and Co-ordinator Eastman, who held out for $35, by obtaining an agreement on $36.375 per gross ton.

Because there was no precedent, in either governmental or railway experience for the procedure involved in this plan, and because it was essential that every step taken conformed strictly to the provisions of the enabling legislation passed by Congress, it was necessary not only to build up an organization charged with the responsibilty of conducting the negotiations, but also to develop the plan of procedure, the necessary legal forms and other requisites. Further complications arose from the fact that under the law, responsibility for the approval of loans and allotment of funds to the railways is divided between the Interstate Commerce Commission and the Public Works Administration, and it was necessary to co-ordinate the functioning of these two bodies.

In the five months that have elapsed since President Roosevelt launched his plan for federal aid in financing railway purchases, more than $200,000,000 has been allocated to various roads. Partly through this means, 33 railways have already ordered, or arranged to order, 588,298 tons of rails or nearly 50 per cent more than all the roads ordered in the 12 months of either of the two preceding years. These loans are also stimulating orders for other maintenance materials. The present status of these negotiations is presented here.

After an informal conference with the Public Works Administration, the railway files a formal application for a loan, followed by the filing of a formal application with the I. C. C. for approval of the expenditure. The next

step is the allotment of the necessary amount of money from P.W.A. funds by a special board of that administration, announcement of which is made as soon as the allotment has been signed by Harold L. Ickes, administrator of public works, and by the President. Next in order of procedure is the approval of the expenditure by the I. C. C., which, either then or subsequently, approves the notes offered by the railroad to obtain the loan, together with any collateral offered as security. The last step is the signing of the formal contract with the P.W.A.

It must be understood, of course, that the $51,000,000 allotment that has been set aside for the financing of rail purchases is only a part of the P.W.A. money that has been made available to the railroads. The Transportation Loan division of the P.W.A. headed by Frank C. Wright, director, formerly vice-president of the Bangor & Aroostook, which is handling the loans in connection with rail purchases, has granted loans to date aggregating about $200,000,000, of which a very large portion covers the purchase of locomotives and cars, and to finance the repair of rolling stock in railway company shops. Included under this head are a number of loans already granted or under consideration for the purchase of railway crossties, for the maintenance and renewal of bridges and, in one case, for the relining of a tunnel. Following are brief summaries of the loans made to date or in process of negotiation, covering the purchase of rail and other track materials, and for other maintenance of way operations.

Rail Orders Placed or Pending, Including Orders Placed Since October 1, 1933

Railroad	Tons of Rail Pending But Not Yet Ordered	Tons of Rail Ordered
A. T. & S. F.	.....	34,700
A. C. L.	.....	5,000
B. & O.*	35,000	.....
Bangor & Aroos.	.....	3,500
B. & M.*	30,000	.....
C. & E. I.*	.....	4,000
C. & N. W.*	.....	26,514
C. B. & Q.	.....	25,000
C. M. St. P. & P.*	20,000	.....
Clinchfield	2,000	500
D. & H.	.....	5,000
D. L. & W.	.....	12,000
Erie*	32,121	.....
I. C.*	21,600	.....
K. O. & G.*	5,184	.....
L. & H. R.	.....	1,000
L. & N. E.	.....	3,202
L. & N.	.....	17,500
M. P.	.....	25,000
N. Y. N. H. & H.*	25,000	.....
N. Y. C.	40,000	.....
N. Y. O. & W.*	4,725	.....
N. & W.	.....	10,000
N. P.	.....	6,500
Pennsylvania*	.....	100,000
Pitts. & W. Va.*	.....	1,000
R. F. & P.	.....	500
St. L.-S. F.	26,000	.....
S. P.*	.....	40,000
Southern	.....	10,000
Wabash*	.....	10,000
West. Md.	.....	4,000
Wis. Cent. (Soo Line)	1,752	.....
Total	243,382	344,916

* Federal Loans granted or pending.

The Baltimore & Ohio has been allotted $4,230,000, part of which is for the laying of 35,000 tons of rail.

The Boston & Maine has received approval from the Interstate Commerce Commission and the Public Works Administration for a loan of $2,327,949, of which $2,008,449 is for the purchase of 9,836 tons of 131-lb. rail, 20,164 tons of 112-lb. rail, and fastenings, tie plates and other track material; $221,500 is for the labor required in applying this material; and $98,000 is for the repair of stations and office buildings.

The Chicago & Eastern Illinois was granted one of the first loans, totaling $251,300, of which $155,388 is for the purchase of 1,000 tons of 110-lb. rail and 3,000 tons of 112-lb. rail, and $95,912 is for the purchase of the following track accessories:

1,000 tons of tie plates
66 tons of spikes
33 tons of track bolts
4,841 rail joints
142 insulated joints
50 compromise joints
69,584 rail anchors
36,000 nut locks
18 spring frogs
15 switches
30 guard rails

The Chicago, Milwaukee, St. Paul & Pacific was the first road to receive a loan, amounting to $1,818,750, but this allotment, covering the purchase of 50,000 tons of rail, was later withdrawn at the request of the railway, which subsequently filed a revised application for $2,066,851, to finance the purchase of 20,000 tons of rail and the necessary fastenings and for $600,000 to be used in the strengthening of bridges and the lengthening of turntables and roundhouse stalls to take care of 30 high speed 4-8-4 freight locomotives which it proposes to purchase with the aid of a loan of $4,004,000, application for which has also been made.

The Chicago & North Western, also among the first to obtain approval for a loan, likewise withdrew its original application covering the purchase of 65,000 tons of rail, and a revised contract covering a loan of $1,400,000 to cover the purchase of 26,514 tons of rail and track materials has been signed. The track materials are as follows:

1,460 tons of rail joints
4,000 tons of tie plates
730 tons of track spikes
181 tons of track bolts
1,066 pairs of insulated joints
180 sets of compromise joints
175,000 nut locks
320,000 rail anchors
100 switches
44,000 rail bonds

The Erie has applied for a loan of $2,048,000 for 29,987 tons of first quality rail, 2,134 tons of second quality rail, and 12,340 tons of track materials.

The Illinois Central has been granted a loan of $9,300,000 for various purposes, of which $1,254,045.40 is for the purchase of 21,600 tons of 112-lb. rail, 65,000 crossties, and track fastenings, frogs, and switches, $183,100 is for the application of these materials and for track surfacing, $167,000 is for the building of a new structure to replace the Big Clifty viaduct, $870,000 is for the construction of new approaches for the Ohio River bridge at Cairo, Ill., and $215,000 is for the relining of the Reevesville tunnel.

The Kansas, Oklahoma & Gulf has obtained approval for a loan of $290,834, of which $188,550 is for 5,184 tons of 110-lb. rail, $74,220 is for fastenings and $28,064 covers the freight charges.

The New York, New Haven & Hartford has obtained approval from the Interstate Commerce Commission for the expenditure of $1,350,000, for which the road has requested a loan for the purchase of 25,000 tons of 112-lb. rail and 10,000 tons of track accessories.

The Northern Pacific has obtained approval from the Interstate Commerce Commission for a loan to finance the purchase of 10 new 4-8-4 passenger locomotives, this

loan to include a sum of $245,000 to be applied to the lengthening of roundhouse stalls and the strengthening of bridges to be made necessary by the operation of these new engines.

The New York, Ontario & Western has applied for a loan of $235,000, of which $171,872 is for 4,725 tons of 90-lb rail and $63,128 is for 1,751 tons of track accessories.

The Pennsylvania was the first road to complete all negotiations for a federal loan, and this in the amount of $77,000,000, to be used primarily for the completion of its great electrification project from New York to Washington, D. C., and allied improvements. This sum embraces $2,380,000 to be expended on bridges and other roadway structures to provide the necessary clearances for the electrified equipment. The Pennsylvania has also been granted an additional loan of $3,650,000 to cover the cost of 100,000 tons of rail that has already been purchased.

The Pittsburgh & West Virginia has received approval from the Interstate Commerce Commission for a loan of $47,000 with which to purchase 1,000 tons of 105-lb rail and the necessary fastenings.

The Southern Pacific has been granted a loan totaling $12,000,000, of which $6,771,985 is for the maintenance of way and structures, including $2,414,500 for the purchase and installing of 1,820,000 ties, $3,051,785 for the purchase and laying of 40,000 tons of rail, together with necessary accessory material, and $1,305,700 for the repair and renewal of bridges. Of this last amount, $803,920 is for material and $501,780 is for labor. The track accessory items are as follows:

3,500 tons of rail joints
460 tons of track bolts
1,280 tons of track spikes
1,258,800 tie plates
800,000 rail anchors
167,000 gage plates

The Wabash has obtained approval from the Interstate Commerce Commission for a loan of $573,506 to cover track material as follows: $87,975 for 2,300 tons of 110-lb. head-free rail, $286,825 for 3,700 tons of 110-lb. R.E. rail, and 4,000 tons of 112-lb. R.E. rail, and $198,706 for track fastenings and frogs and switches.

The Wisconsin Central (operated under lease by the Minneapolis, St. Paul & Sault Ste. Marie) has applied for a loan of $115,000 to finance the purchase of 1,752 tons of rail and 135,098 tie plates.

What Is Ahead?

(Continued from page 132)

for which federal loans have been obtained is evidence of the urgent needs in this field.

The deficiency in the maintenance of buildings is manifested by the appearance of the passenger stations along even the most important lines. The need for painting, and for the repair of roofs, gutters and downspouts is clearly evident. The curtailment of painting programs is also shown by the condition of steel bridges, although the neglect here is not so extreme or as general as with buildings and roadway signs. In general, maintenance work on buildings during the last four years has been reduced progressively to the status of emergency repairs, operations being confined to such work as is necessary to insure against failure or the development of serious deterioration.

Expenditures for building maintenance have been reduced to no small extent by extensive campaigns for the abandonment of buildings—way stations that have ceased to be a source of revenue and a multitude of roadway and terminal structures that serve no useful purpose at the present time. Many of these will never be used again but there are some that will be needed with a revival of traffic and when this need is asserted not a few of them will be found unfit for use.

Water Service—Too Little Reserve

The general trend of maintenance operations as they have been conducted on bridges and buildings is to be observed also in the case of coaling stations, cinder plants, turntables, water service facilities and the like, major attention having been given to those units or parts of units, turntables, for example, which must continue to function if traffic delays are to be avoided. In the case of water stations, attention has been focused on measures designed to keep a sufficient number of units, such as pumps and wells, in condition to meet current demands for water. There is considerable evidence to support the conclusion that an appreciable increase in traffic, a protracted drought or other emergency conditions would find many roads with little or no reserve capacity.

Attention was directed in an earlier paragraph to the fact that expenditures for roadway maintenance for some years prior to 1930 embodied appreciable sums chargeable to operation incident to extensive improvement programs. The same is true also of the expenditures for the maintenance of water service facilities. Consequently, any comparison of expenditures for water service maintenance in the years prior to and after 1930 to ascertain the extent of the deferred maintenance would develop exorbitant figures, if the influence of the relative amount of improvement work in progress in the two periods were not taken into account. This is true if the objective is solely that of determining deficiencies in maintenance, but it does not apply in an effort to determine the probable expenditures on water supply facilities to be made in the future. That the improvement programs that were suspended in 1929 and 1930 are by no means complete is evident from the fact that there are still many water stations that have not yet been modernized.

Conclusions

What are the immediate needs? It has been shown that there has been a large deficiency in the renewals of ties. The same holds true of rails, trackwork and wooden bridges. Because of the excellent condition of the properties in 1929, it has been possible to keep many elements in shape to handle traffic with a minimum of expenditures by means of what might be termed superficial repairs, but such items as out-of-face surfacing, ditching and other major operations must be resumed on an extended scale if the tracks are to be kept in a serviceable condition at a reasonable ultimate outlay. There is also an enormous accumulation of deferred work on buildings, terminal facilities, water and coal service facilities, and other elements of the property, the condition of which bears no relation to the safety of train operation.

The correction of deficiencies such as those cited is but a start. If the program for the improved physical condition of the fixed properties, so abruptly interrupted in 1929, was founded on sound economics, and there is ample evidence that it was, then the railways will not be assured an attainment of ultimate economy in the use of these fixed properties until this program is resumed on a scale approaching that which prevailed prior to the depression.

In What

A discussion of the extent to which it has deteriorated from lack of use, failure to repair or replace worn machines and the continuance in active use of obsolete units

HOW many units of work equipment could the railways place in service immediately if the necessity arose? How many of them should be retired? In other words, what is the present condition of this equipment? To what extent has it deteriorated during the last four years through lack of use and neglect? How much of it is worn out? To what extent have those units that have been kept in service been under-maintained? How much of it is obsolete? In view of the great accumulation of deferred maintenance, the marked improvement in general business that is now taking place, the continued gain in car loadings and the necessity for increasing maintenance activities to prepare for the still larger volume of traffic that is in prospect, the foregoing questions present a problem that every maintenance officer is facing and to which he must shortly give intensive consideration.

It has been less than a generation since work equipment began to come into use and during this period of transition from hand to machine methods, no maintenance officer has been confronted with a surplus of power machines. In fact, these officers have often been hard pressed to assign the machines that were available in such a way that they could complete the work that was most urgent. The natural result was that, despite large purchases of new equipment, many of the older units have been kept in service beyond the limit of economical repairs or long after they had become obsolete.

Many Units Idle in Storage

Almost over night, four years ago, this situation changed, and instead of looking forward to the time when their forces would be adequately equipped with up-to-date machines to perform all of their work with maximum economy, maintenance officers found themselves in possession of a great variety of equipment for which they had little use. While this was not true of all classes of work equipment, it was of all but a few. As the crash came at the close of the 1929 working season, many of these machines were scheduled for heavy repairs which would normally have been made during the winter while they were idle. In some cases, these repairs were made according to schedule; in many others, because of reduced appropriations, they were not, the machines being stored as they were until conditions would again become favorable for their use, and they have remained idle since that time.

Since maintenance appropriations continued to shrink, on many roads a large number of machines are still in storage without having been repaired since they were released from service in the fall of 1929. On the other hand, maintenance forces were reduced to the point where the need for certain types of equipment became far more acute than in the previous period when hand labor was more readily available, and in general some or all of the machines of these classes have been kept in almost constant service.

Tie tampers particularly have been a boon to the railways, for it is generally recognized, in view of the small number of trackmen that they have been able to employ, that without them the main tracks could not have been kept in condition for the high train speeds that competitive conditions have demanded. As a consequence of the urgent need for this equipment, it has generally been kept in excellent repair. It must be borne in mind, however, that many of the power plants and tamping tools were approaching the limit of their economical service life four years ago when the recession in maintenance expenditures began. Furthermore, during this period they have been used more intensively than ever before, with the result that many units have been retained in service only out of sheer necessity. In not a few instances the need has been so great that where new machines have been purchased, the old ones have been continued in service, rather than being retired, despite their loss in efficiency and the high cost of repairs and operation.

As a consequence of this intensive use and despite the efforts that have been made to keep these units in repair, it is contended that substantially all of the older equipment of this type should be retired. This is true also of a considerable percentage of later units that were rated as being in excellent condition as recently as four years ago. In this connection, so impressive have been the economic benefits from mechanical tamping that it is almost a certainty that every unit retired will be replaced with a new and more modern machine.

In some respects motor cars afford a striking contrast to tie tampers. Universally recognized as a necessity for the economical transportation of men to and from work, maintenance officers have been working for two decades

Condition Is Work Equipment Today?

toward the objective of ample equipment of this type for all of their forces. As a result of the changes in organization brought about by the depression, however, maintenance officers were suddenly confronted with a surplus, instead of a deficiency, of motor cars, in some cases as great as 100 per cent.

Prior to this time the situation with respect to motor cars was similar to that of other types of equipment, in that only a part of the new cars purchased were for replacement. The result of this practice has been that from 35 to 40 per cent of all motor cars in service are now more than 10 years old and of these, 40 per cent have been in service more than 15 years. In consequence of this practice of using new cars to increase the number in service rather than to retire the older units, obsolescence has heretofore been given little consideration by the railways. In view of the marked advances that have been made in recent years in motor car design and the opportunities that still remain for improvement, it is not debatable that many of the cars now owned by the railways are out of date and that obsolescence will be an important factor in making future retirements.

Much work equipment has been in storage for four years. Most of it is of the older designs. While in storage it has been "robbed" of parts for repair purposes.

As working programs are increased and more equipment needed, the question arises whether it is practicable to rehabilitate this stored equipment. Has it deteriorated to the point where it is no longer worth repairing? Would it be cheaper to scrap it and buy more modern and more efficient units? These are high points in a problem confronting maintenance of way officers today.

Another factor that has an important bearing is that in an effort to avoid expenditures for new materials, many of the stored cars have been "robbed" to obtain repair parts for those that have been continued in use. In fact, between obsolescence and the amount that must be spent to refit many of the cars now stored, one officer recently estimated that not more than one-half of those on his road will ever be returned to service. Others estimate that none of the idle cars will be restored to service, but that lighter cars capable of more economical operation will be purchased in preference.

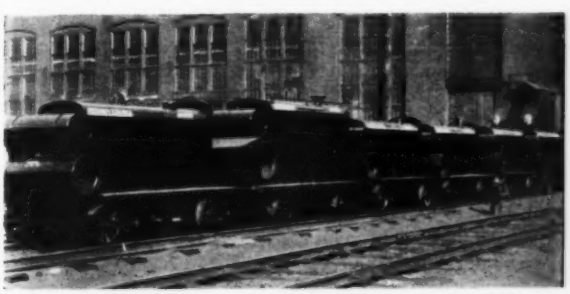
Rail-laying cranes represent a type of equipment with somewhat different characteristics than the types that have already been mentioned, in that they are adapted for many forms of service other than that for which they are primarily designed. During the period from which we are now emerging, there has been little for them to do in laying rail. On the other hand, they have been in demand for handling materials in bridge repairs, for picking up materials, renewing frogs and crossings and other work of similar character.

Again, other departments have been quick to take advantage of the opportunity thus offered to obtain the use of otherwise idle rail cranes. On a number of roads, this equipment has been turned over to the stores department for handling heavy materials and scrap and to the mechanical department for dismantling retired freight cars. As a consequence of these demands, a considerable number of rail cranes have been kept in repair. On the other hand, there are many units of the older types which will require expensive repairs if they are to be retained, while operating costs are much higher than in those of recent design.

Much Equipment Has Been Idle

Owing to the continued reduction in forces, it has been found impossible in many cases to maintain even a semblance of surface drainage without mechanical aid. For this reason, ditching machines have been kept in service to a greater extent than many other types. Many of these machines are large and complicated, however, and require shop facilities and workmanship that are beyond the resources of the maintenance of way department on most roads. As a consequence, most of the roads have made it a practice to depend on the mechanical department for heavy repairs and often for running repairs as well. But mechanical department forces have suffered from the same drastic reductions as the maintenance forces, with the result that it has not been possible to maintain roadway equipment of this type as formerly, so that, generally, ditching machines have been undermaintained and many of them are today in poor condition, while a large percentage of the remainder can at best be rated as only fair.

Except on a few roads, during the last four years there has been little use for ballast equipment, including ballast plows, power jacks, power ballasters and ballast cars. In some cases, equipment coming within this category was given a thorough overhauling before it was stored; in others, it was stored without being repaired. Equipment of this type, in common with many others, suffers considerable deterioration when idle, particularly if it is not well protected during storage. A measurable amount of deterioration has, therefore, occurred to ballasting equipment.



In numerous instances, ballast cars and air-dump cars used normally for ditching and grading have been assigned to cinder-disposal service in an effort to reduce the amount of labor required for unloading. While it has been necessary to maintain the running gear, brakes, draft rigging and other safety features in accordance with Interstate Commerce Commission requirements, other features of their construction have often been neglected. In fact, on some roads, when cars assigned to this service have become "bad order," they have been stored in this condition to avoid making the expenditures necessary for repairs, and others that were fit for service have been substituted. As a consequence, while most of them can be returned to service, a considerable number will require extensive repairs before they can be used again.

Another item of maintenance with which the reduced forces in this department have been unable to cope without mechanical aid is that of weed destruction. For this reason, ballast discers, mowing machines and weed burners have been used extensively during the depression to keep the track and the shoulders of the ballast and roadbed free of vegetation. On most roads, weed-destroying equipment was in good repair at the end of 1929, for at that time most ballast discers and track mowing machines were relatively new. Since then, however, most of these machines have been used intensively and in many cases they have not been maintained to their former standard, so that at present many of them are in such poor condition that they cannot be continued in service without excessive expenditures for repairs. If conditions are at all favorable, it is likely, therefore, that a relatively large number of these machines will be retired and replaced with equipment of later design.

Maintenance Has Been at Low Ebb

It is not possible to discuss every class of work equipment in detail, nor would there be any benefit in doing so, since, in most cases, such discussion would merely be a repetition of what has already been said. The facts that have been presented with respect to the present physical condition of work equipment have been gathered from maintenance officers and supervisors of work equipment on roads that are believed to be representative of all of the railways.

On some roads, because of lack of facilities to do otherwise, certain classes of equipment have been stored in the open or elsewhere without proper protection, while others have been well cared for in this respect. In other instances, maintenance officers have gone to considerable length to see that all equipment has been provided with the best protection that could be made available.

What has been said about "robbing" surplus motor cars of parts to keep others in service without purchasing repair materials, is also true of other classes of work equipment. In not a few instances, stored machines and tools have been "robbed" in this manner until they are practically dismantled. Several officers report that it will cost nearly as much in labor and material to recondition some of their machines as to buy new ones, and that, in view of the improvements that have been made in design and efficiency, they prefer to buy new units.

This brings up the question of obsolescence. What is obsolescence? Conversations with maintenance officers indicate a wide divergence in their understanding of this important subject. Some think of obsolescence in terms of physical condition. That is, they hold that when a machine has become worn to such an extent that it can no longer be kept in good operating condition, or that to do so requires excessive maintenance, it has become obsolescent. Others view obsolescence as a matter of operating convenience, regardless of physical condition, while still others look on it as a question of whether the equipment is adapted for the work in hand. An increasing number of these officers, however, are beginning to consider that obsolescence is a matter of relative efficiency.

While the dictionary defines obsolescence as the process of wearing out or of falling into decay or disuse, as applied to railway work equipment it has several implications, all of which are related primarily to efficiency or economy. As an example, it was formerly necessary to provide section gangs with motor cars designed to carry from 6 to 12 men. At the time they were purchased, cars weighing from 1,100 to 1,400 lb. were considered necessary to insure sufficient traction for hauling one or more trailers loaded with ties or other track material. Today, owing to the reduced size of section gangs, this seating capacity is no longer needed, while the cars are too heavy to be taken off or replaced on the track by the few men constituting the present gangs. These cars are, therefore, obsolescent, because they are no longer adapted for the service for which they were formerly used. This feature of obsolescence is all the more striking since lighter cars weighing from 450 to 525 lb. are now available. Furthermore, ignoring the inability of the gangs to handle the heavier cars and considering obsolescence from the standpoint of economy alone, replacement of the older cars can be justified by reduced fuel consumption, smaller maintenance and greater safety of operation.

That operating costs of older equipment as compared with newer designs may make the former obsolescent is illustrated by portable air compressors. Until recently, only single-stage, or straight-line, compressors were available in portable units. At best, a straight-line compressor is inefficient. Furthermore, these units were heavy and difficult to put on or remove from the track—a serious disadvantage, particularly when they were used in connection with laying rail on single track. At present, two-stage compressors are available, with provision for inter-cooling and removal of moisture, on far lighter mountings. Owing to the increased efficiency of two-stage compression, fuel consumption is greatly reduced; the dryer air that is delivered increases the efficiency of the air tools and decreases trouble from frost; the later designs are self-propelled while in operation, as contrasted with the older models which require a separate car to handle them; while the amount of labor necessary to handle them on and off the track is enough less to constitute in itself a real factor in the economy of their operation.

Development of off-track designs is rapidly creating obsolescence in certain classes of work equipment, which, in themselves, demonstrate a high degree of mechanical efficiency and of economy in operation, but which are confined to the track and require the service of a work train when in use. Work train costs have increased in recent years to such a degree that they add a large increment to the unit cost of work. Off-track units that can do the same work as cheaply as those that are confined to the rails have the advantage that they eliminate the necessity for work trains and, in addition, can be used on work that is beyond the reach of rail-bound equipment.

It is not debatable that the railways are retaining and using many units of work equipment which, if used by a commercial concern, would soon bankrupt their owners. If maintenance officers were to analyze all of their equipment on the basis of comparative costs of maintenance and operation, many of them would be amazed at the results and in the words of one who has done so, they would find that "we simply can't afford to retain these older machines because the later designs demonstrate economies of such magnitude."

Should We Use Less Machines and More Men?

A discussion of the influence of mechanical equipment on employment in the maintenance of way department

Although the mechanization of industry has improved the economic status of a large part of the world's population, every advance in the introduction of machinery has been met with bitter opposition, and in these days of widespread unemployment the benefits to be gained from the intensive use of mechanical appliances are being seriously questioned in many quarters. Because of its interest to maintenance of way officers, this problem is discussed here from the standpoint of its application to work on roadway and structures.

WHILE the depression that followed the stock market panic of October, 1929, has closed banks, destroyed many fortunes, wiped out the savings of millions and exhausted the credit of cities, none of these effects present such a serious obstacle to the restoration of normal commercial activity as the unprecedented unemployment which has beset the American people during the last three years. And it is not too much to say that a large part of the measures initiated by the federal government during the last year have for their chief objective the increasing of employment. Because of the obvious implications of the term "labor-saving machinery," it is not surprising that attention has been directed to the possible effect of mechanical equipment in reducing opportunities for employment.

This quest is especially pertinent with respect to maintenance of way work because it is only within a comparatively short period that labor-saving machinery has become a factor in this field, and the history of the machine age, which had its beginning a little more than 150 years ago, is replete with instances of serious economic and social disturbances following the introduction of power equipment in one industry after another. In each case, it has taken some time to adjust relationships between production, employment, working hours, wages and prices.

However, before considering the effect of labor-saving machinery on maintenance of way work, it is well to look at another side of the general picture, namely, the composite effect of mechanization over a long period. It has been demonstrated by statistics embracing a record of more than a century that real wages, or wages expressed in buying power, have increased with the volume of production per individual employed. And it has been contended without contradiction that the greater purchasing power and the higher standards of living of the American people, compared with those in other lands, have resulted almost entirely from the enlarged productivity made possible by the greater use of machinery and the larger consumption of power per individual employed. No better example can be cited than that offered by the railways themselves, which comprise the outstanding example of machinery applied to transportation—every man, woman and child enjoys untold advantages in the form of lower living costs because of the cheap transportation of goods that they have made possible.

But this long range approach to the subject does not help to solve the acute problem of unemployment that now confronts us, nor does it provide an effective answer to those who contend that the machine is the primary cause of the privations of the many who want work but cannot find it. There is, in fact, a large group who have been so vehement in their criticisms and so insistent that we should return to the pick and shovel that their views cannot be ignored. Moreover, their influence has produced some measurable results, notably through the C. W. A. There are not a few railway men, also, who lean toward this same viewpoint as applied to maintenance of way work, and who feel that the railroads, along with the C. W. A., should "make more work" by abandoning the use of machines.

In considering the activities of the C. W. A., it must be kept in mind that it is primarily a relief measure—a direct substitute for the outright distribution of an equal amount of money. While there is some justification for the argument that it creates a better morale among the men so employed, it is to be questioned whether any intelligent man derives satisfaction from doing work by hand that he knows could be done cheaper and better with a machine.

Deferred Maintenance

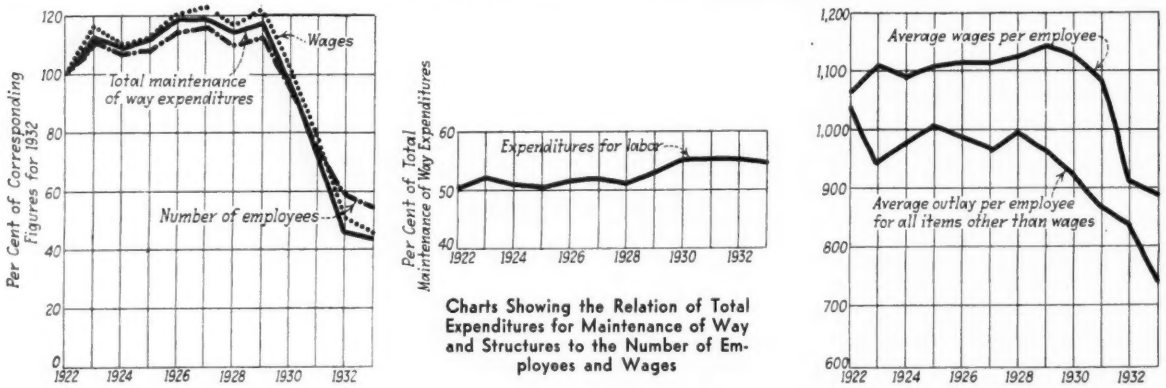
As has been shown in an article on a preceding page, the railways have accumulated an enormous volume of deferred maintenance that must be made good. Consequently, the matter of "making work" to give employment does not enter the picture. Therefore, the number of men employed is not now a function of the amount of work to be done, but of the amount of money that can be provided. Thanks to the upturn in earnings and to the loans being made by the federal government, the railways will spend more money for maintenance of way and structures this year, but even with the most intensive use of machinery that could be conceived there is not the remotest chance of any curtailment of employment by

reason of the completion of the work that needs to be done. The use of machinery will not result, therefore, in the employment of any less men, but instead it will permit the completion of more work and thus place the railroads more nearly in the condition necessary for maximum efficiency in the movement of the nation's traffic.

The discussion thus far has had to do solely with the effect of machinery or employment under depression conditions or in the face of inadequate maintenance. But what was the trend of employment when times were good, specifically, during the period when the railways were increasing the use of mechanical equipment? Let us consider the years 1922 to 1929, inclusive, this being the period of most intensive application of power equipment to work on tracks and structures. Did this development result in a reduction in employment? Let us look at the figures.

In 1922, the expenditures of the Class I railways and terminal companies for maintenance of way and structures were $731,181,000, the average number of employees was 362,768 and the wages paid totaled $384,993,000. In 1929, the total expenditures were $864,105,000, the employees averaged 411,210 and the wages totaled $468,025,000. Or, expressed in another way, expenditures increased 18 per cent, and wages 22 per cent.

These data can be expressed in another way. In 1922 the average annual wage paid in the maintenance of way department was $1062, while the amount of money spent for materials and supplies and in operating charges incident to the purchase of work equipment was equal to $1038 per employee. In 1929 the average wage was $1140, while the expenditure for materials, supplies and equipment charged to maintenance was only $965 per employee. In 1922, also, labor consumed 50.5 per cent of all maintenance of way expenditures; in 1929 labor amounted to 52.8 per cent.



Charts Showing the Relation of Total Expenditures for Maintenance of Way and Structures to the Number of Employees and Wages

These figures show clearly that both the number of employees and the wages paid increased rather than decreased during the period of the greatest advance in the application of power tools and equipment. This does not mean that the use of power tools has not resulted in some reduction in employment, but here again the answer is obscured by the fact that, even in 1929, expenditures for maintenance necessarily bore some relation to earnings.

What Appliances Should Be Discarded?

It is one thing to suggest that the railways should abandon the use of labor-saving equipment in the interest of greater opportunity for employment, but it is another thing to list the appliances that should be retired. There is ample precedent in C. W. A. work for the elimination of the power shovel, but as many of the C. W. A. workers ride to their jobs in trucks, is it to be inferred that the track motor car should be retained? Ditching can be done with picks, shovels and wheel barrows, but does that justify the elimination of ditchers and dump cars? Does the fact that the Chinese still drive piles by hand warrant the elimination of the pile driver?

It may be argued that these appliances, together with the pneumatic riveter and certain other equipment, have been in use for so many years that any social or economic maladjustment that their introduction may have caused has long since been corrected, and that the process of elimination should be confined to appliances of more recent introduction. But such a differentiation is purely theoretical, for as a practical matter, if the objective is to create the most work, the greatest gain will be attended by the elimination of those machines that save the most labor, regardless of how long they have been in use.

Should the elimination of modern appliances or methods be confined to those that save labor directly, or should it embrace also those agencies that are primarily responsible for the conservation of materials but which have indirectly effected a profound reduction in the demand for labor? It is necessary to mention only two—the reduction in rail renewals by the application of welding processes in the building up of battered ends, and the marked decrease in tie renewals that has attended the preservation of ties from decay.

Do All Machines Pay Their Way?

But some of the advocates of a greater use of hand tools contend that some power equipment is without economic justification because its use can show no saving if all elements of cost are taken into account. It is implied also that the true cost of owning and operating machines that fall in this category is not always revealed because such a disclosure would reflect unfavorably on the officers whose recommendations resulted in their acquisition. Expensive mistakes are the penalty paid by any individual or organization that has the courage to pursue an uncharted course, and to declare that no mistakes have been made by maintenance of way officers during the last 20 years of experimentation in labor-saving machinery, is but to disclose a grievously inadequate knowledge of what has transpired during this interesting period. There have been plenty of false starts, the cost of which must be charged to development. It is true, also, that some enthusiasts have been slow to see the defects in their pet projects, and in some few instances they have attempted to cover up their mistakes.

Such a policy is as futile as it is unethical, for the true facts will come out in the end, and no device or practice can survive long on a doctored service record. An ill-conceived appliance that is not soon discarded through

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Quality or Price, Which Should Govern?

Maintenance officers express their views on the effect that good and poor tools have on output, character of the work, morale and the safety record

Good Tools Increase the Morale of Gangs

NEARLY every workman prefers certain brands of tools. Is this preference based on fact or fancy? Is there a real difference in quality, and can this be demonstrated? Is there a difference in service life? Does quality affect output, character of work, morale or safety? These are questions that must be answered by railway officers responsible for selecting the tools with which to equip their forces. Probably no such officer ever prefers tools that are of other than the highest quality. But where cost must be considered in the selection of tools, is it possible for him to present evidence that will substantiate his request for tools of demonstrated merit, but of higher price?

To determine the extent to which maintenance officers believe that there is any difference in the results that are obtained with tools that are sold on the basis of quality, as compared with those that are sold on price alone, a selected list of 17 officers, ranging from chief engineers and engineers maintenance of way to foremen engaged in the maintenance of roadway and track, bridges and buildings, and water service, were asked to give their experience with tools of these two groups. These men represented approximately 70,000 miles of road, or one-fourth of the mileage of the United States and Canada.

Is the lowest priced tool the cheapest? Is quality merely a talking point or is there a difference? On what grounds can one justify the purchase of more expensive tools? Can a purchasing agent be "shown" the quality in tools? These are among the questions submitted to and answered by seventeen maintenance officers from their first-hand experience on the right of way.

Does quality affect service life? Few records have been kept in such shape as to permit actual comparisons to be made with respect to the relative service rendered by tools of different qualities, either as to total life of service between periodic repair, dressing, etc. Some roads have made tests to determine the relative quality of tools of different makes and have compared the service life obtained from each. These tests have generally been informal, however, and while the reports are specific, they do not contain the data necessary to afford a comparison of the performance of the different tools under identical or nearly identical conditions.

One officer of long experience in track work considers records of service life unnecessary so far as hand tools are concerned, since a poor tool can be recognized as such as soon as it is put into service. Furthermore, such a tool is still further degraded after it has been in the shop for repair, while high quality tools are returned in excellent condition, provided they have been given proper attention while in the shop. Another officer cited an instance of a sledge that has been in daily service for 37 years with only slight repairs. This compares with the experience of a third officer who has had sledges that lasted only a few months and were unsatisfactory during most of that time.

Nearly every reply received from officers engaged in track maintenance mentioned the track chisel as a tool whose use is particularly affected by quality. Instances were given of chisels that failed before they had cut one rail, either through breakage or dulling of the edge. By comparison, repeated cuts had been made with chisels of high quality before they required sharpening.

Two interesting examples were given of the trouble experienced with inferior saws. In one case, two crosscut saws, one a high-grade tool and the other of inferior quality, were received at the same time and used on identical work. The better saw had more than twice the life of the inferior one and the cost of keeping it sharp was less than one-third. In fact, the latter required sharpening and setting oftener than once a day, while the former held its set and edge for several days. In the other instance, there was a similar experience with two hand saws, while the cheaper one also gave constant trouble from bending and kinking.

Almost every other tool used by trackmen, bridge and building men and water service repairmen, including shovels, adzes, axes, scythes, tamping and clay picks, claw bars, drill bits, lining bars, cant hooks, rail and tie tongs, pipe cutters, wrenches and others too numerous to mention, came in for similar discussion.

Is there any difference in the amount of work that a man does when he is provided with a good tool, as compared with his output when he must work with an

inferior one? No consideration of tools can properly omit this important factor, the study of which should include (1) the effort he must apply in using the tools and (2) the morale that is engendered in both the individual and the gang.

Does a good tool require less effort than a poor one to accomplish a given amount of work? The testimony on this point was unanimous that output depends in large measure on the quality of the tools with which the men must work. Taking track chisels as an example, one reply stated that there is a marked increase in the time required to cut a rail with an inferior chisel, as compared with a good one. Another said that "so far as results are concerned, one good track chisel is worth a dozen poor ones, since the labor saved will more than pay the increased cost of the superior tools."

Claw bars were also cited as an example of the time and effort that can be wasted through the use of inferior tools. It was stated that with this tool, in common with many others, inferior quality is often accompanied by inferior design. If the jaws cannot be set under the spike head, two men, one with a maul to drive them under, must be assigned to each claw bar. If the metal in the jaws is inferior or improperly heat treated, they soon wear or the edges break and the tool must be discarded. Again, unless the metal is properly heat treated, the shaft is likely to bend and the tool becomes unfit for further use. As a result of these defects, the time wasted in a single day may often represent more than the difference in cost necessary to equip the gang with high-grade claw bars.

Men Will Fight for Good Shovels

In discussing the effect of quality on output, one officer said that "it is not debatable that the quality of tools influences output, although it is difficult to express the difference in either dollars and cents or percentages. A good place to observe the effect of tools on the output of trackmen is with a gang laying rail or applying ballast. In both operations, cutting, percussion and force-applying tools are in constant demand. If the gang is equipped with tools of the proper quality and design, the work will proceed with precision and speed. On the other hand, if the tools are inferior, there will be delays and lack of co-ordination that will be reflected in an increase in the cost of the work, which may amount to as much or more than the cost of the tools. The same observation applies also to section work, and although the amount involved for individual sections is relatively smaller, the aggregate is large when all sections are included."

In another somewhat similar statement it was emphasized that these losses are not for a day only but continue throughout the season, or until the gang is disbanded, and are repeated in succeeding seasons unless better tools are provided. It was also stressed that the design of tools is important and should receive as much attention as physical quality.

In connection with cutting tools, several persons observed that high grade tools, as compared with those of lower quality, take keener edges, hold them longer and can be made to follow desired lines with less effort. For this reason, production is increased, since less time is required for going back over the work and dressing it up. Furthermore, much time is required for sharpening and dressing poor tools, which might otherwise be spent in productive effort.

"We have found that superior tools increase the production per man-hour and give the man performing the work an incentive to do good work as well as produce more," said the chief engineer of an eastern road, who added that "the average man will do from 5 to 10 per cent more work in a given time with a tool which he feels is doing a satisfactory job and which he can handle without unnecessary effort."

Is morale improved by superior tools? There was no dissenting opinion on this point, every reply being in agreement that it is. As one engineer maintenance of way put it, "there is no question about this, for a high-class tool produces a greater output for the same effort and at the same time keeps the user more contented and in a more cheerful frame of mind, which in turn is reflected in better as well as more work."

Another officer who has had long experience in both the bridge and building and water service departments said that "when men are provided with the best quality of tools, they produce better work and their morale is improved, for the simple reason that with such tools they can do a good job. As a rule, the best men in these departments take a great deal of pride in the quality of their workmanship and if they get hold of a cheap tool, they will soon discard it and purchase one with their own funds, keeping it exclusively for their own use."

Commenting on lining bars, a trackman of long experience in the use of tools referred to the fact that lining bars of inferior quality tend to bend, particularly when lining heavy track, thus reducing the morale of the lining gang, since a bent lining bar is a complete nuisance and can be handled only with great difficulty. He also observed that "more than once, I have seen a man who was using a low-grade claw bar allow his temper to get the better of him and throw the tool down, leaving his work to search for a better one."

Shovels came in for considerable discussion with respect to both shape and quality, several replies stating that inferior shovels are generally poorly shaped and without proper balance and are, therefore, awkward to handle so that they tire the user. One man commented that trackmen are particularly sensitive with respect to shovels and often watch for an opportunity to throw a poor shovel into the weeds where it will be lost. Again it was remarked that shovels are frequently broken purposely when inferior tools of this type are provided, because the men do not want to use them. It was also reported that many men hunt through new shipments to secure a shovel that is to their liking and stamp or carve their initials on the handle to identify it. "Not a few fights have occurred," it was said, "because one workman has tried to possess himself of a good shovel claimed by another."

Speaking of tools in general, it was observed in one reply that "every workman wants good tools, and his

morale is quickly affected by poor ones. He soon loses interest, after which both the quality and the quantity of his work suffer. We would not give a high-class mechanic poor tools and expect him to turn out first-grade work, and the same principle applies to maintenance of way work in greater degree than is often realized."

Crosscut saws were mentioned particularly as tools that should always be purchased on a quality basis, "for there is nothing quite so exasperating or that is calculated to destroy the energy and enthusiasm of a workman so effectively as a saw that will not retain a good cutting edge or hold its set."

Does Quality Increase Safety?

How does difference in the quality of tools affect the accident record? It was generally conceded that there are less accidents where better tools are provided than where inferior grades must be used. It is often difficult, however, to trace accidents to the source and determine specifically that they were caused by tools of inferior quality, since there may be other factors involved. For instance, a man using a bent lining bar, or a bent and otherwise defective claw bar, slips and falls across the rail, fracturing several ribs. While there may be a moral certainty that the tool was the real cause of his slipping, it is difficult to prove that he would not have slipped if he had been using a tool of the highest quality obtainable. Again, a man cuts his foot with an inferior adze. But who can say that a high-grade adze might not have been allowed to get dull and have caused the injury?

When it comes to percussion tools and track jacks, however, the situation is different. Where inferior jacks are used, they frequently cause accidents, which are usually traceable to ill-fitting ratchets. Most of the replies point to inferior percussion tools as another frequent source of personal injury. A typical comment was that "difference in quality unquestionably affects

Inferior Claw Bars Waste Much Time

the accident record, especially in certain types of tools. This was clearly demonstrated several years ago when we were beginning to use alloy steels in mauls, sledges, chisels, etc., or in other words, in the percussion tools. Owing to poor plant practice or some other cause, a great deal of trouble was experienced from chipping and even complete shattering of these tools. The personal injuries that resulted were serious, with respect to both number and type." Another comment was that "even though chisels of the best quality are provided, they eventually develop mushroom heads and frayed cutting edges. This applies only in a less degree to mauls and sledges. If the quality is poor, these developments are likely to be rapid and personal injuries frequent."

In this connection, several replies included a warning that "even though the tools be of the best quality, in the interest of safety it is essential that they be given intelligent care and careful maintenance, and that they be used properly. Otherwise the accident record cannot be kept clear." Another comment was that "proper maintenance of tools affects the accident record, as the very best tools will cause personal injuries, unless they are properly cared for and maintained. This is fully as important as providing good tools in the first place."

What Is the Effect on the Quality of Work?

How does quality in tools affect the quality of the work on which they are used? It was the general view that the quality of the work produced is closely related to production and morale, as well as directly to the

High Quality Is Demanded in Striking and Cutting Tools

quality of the tools with which it is done. A representative comment on this subject was that, "A good man cannot do good work with poor tools. Obviously, then, a poor workman cannot do good work with such tools. A good man with good tools can do a high-class job with greater output and will be more contented. A poor man with good tools will do better work than with poor tools and will also be more cheerful." Among the remaining comments, a water engineer said that "the quality of the work performed is affected directly by the quality of the tools used." Another remarked that "there is no question that providing the proper grade of tools exerts a strong influence toward securing good workmanship and keeping up the morale of the forces."

From a section foreman came this comment, "tools are the means by which men apply their skill to accomplish some task. If the tools are suitable and of good quality, they can do this well. If they are poor—the answer is obvious." In the same vein, a supervisor of bridges and buildings remarked that, "if quality work is desired, first consideration should be given to quality in tools. No workman can do well with a poor tool, and the time he spends trying to keep it in shape is a dead loss, so far as production is concerned. Furthermore, he soon loses interest and it is not long before his morale is at low ebb. Poor tools can do more to ruin a gang of good workmen than almost anything else."

Why Are Poor Tools Used?

What efforts do you make to secure tools of demonstrated merit, even though they may be higher in first cost? Do you find a sympathetic ear with your purchasing department? This question was asked for the purpose of finding out whether tools are being bought on

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Economical Track Maintenance Demands Clean Ballast*

A discussion of the need for, the methods employed, and the equipment available for removing dirt from stone ballasted track

By NEAL D. HOWARD,
Eastern Editor, Railway Engineering and Maintenance

CLEAN, crushed stone ballast of proper hardness and properly graded is recognized as one of the most satisfactory, if not the most satisfactory, types of ballast for dense traffic lines with heavy wheel loads. Incidentally, it is also one of the most expensive ballasts. Unfortunately, even the best stone loses much of its advantage as ballast when it becomes fouled with dirt, cinders, coal dust or other debris. To retain its original effectiveness, it must be kept clean—and this can be accomplished only by periodic removal of the dirt.

This elementary requirement assumes large proportions on roads with many miles of stone ballasted track, especially where traffic and other conditions are particularly productive of dirty track. It raises so many questions in the minds of track maintenance men that an attempt is made here to throw added light on at least some of the more important points of debate, out of the experiences of a group of maintenance officers who have jurisdiction over many miles of stone ballasted track.

Altogether, 14 chief maintenance officers of as many roads have contributed to the discussion which follows, these officers having charge of more than 40,000 miles of stone ballasted track, principally in multiple-track territory. Quite naturally, since the use of crushed stone for ballast is confined largely to the heavy traffic roads of the East, the information presented here has come principally from the officers of these roads. While a number of the chief maintenance officers of western and southern roads were also questioned, most of the roads in these sections of the country use other materials than stone for ballast. One exception is the Southern Pacific, which has a large mileage of tracks ballasted with crushed stone, but W. H. Kirkbride, chief engineer, reports that since oil is used for locomotive fuel, the problem of cleaning ballast, as imposed on eastern coal-burning roads, does not exist on that line.

Clean Ballast Is of Prime Importance

The problem of cleaning ballast is of particular importance at this time, both because of the approach of the season for such work, and because ballast cleaning, like practically all other maintenance of way work, has had to share in retrenchment on most roads during the last two or three years. This condition is not universal, however, for certain roads, in spite of reduced appropriations for maintenance of way, have maintained or enlarged their ballast cleaning programs during the last two or three years in the belief that clean ballast is essential to the curtailment of much other maintenance work.

All of the officers asked specifically on this point stressed the importance of keeping stone ballast clean. Armstrong Chinn, chief engineer of the Alton, and M. H. Doughty, engineer maintenance of way of the Delaware, Lackawanna & Western, among others, stressed the importance of drainage, and the effect of clean ballast on it. To use Mr. Chinn's words, "There is nothing more important to good track maintenance than clean ballast." J. C. Patterson, chief engineer maintenance of way of the Erie, A. L. Bartlett, engineer maintenance of way of the New Haven, and Earl Stimson, chief engineer maintenance of the Baltimore & Ohio, used almost the same words, in classing ballast cleaning as of prime importance to economical maintenance and satisfactory track surface. Mr. Stimson added that only ties and rails are of greater importance.

Among the many advantages attributed to clean ballast by these men were better drainage; smoother riding and more stable track surface, with largely decreased expense for lining and surfacing; increased life of rail, joints and ties; less heaving of the track in winter; greater safety; and less dusty track from the standpoint of passenger traffic. To these G. A. Phillips, now chief engineer of the Delaware, Lackawanna & Western, but until February 1, chief engineer maintenance of the Lehigh Valley, added the saving in stone due to cleaning, pointing out that as a result of the increase in the volume of the ballast that was secured through cleaning in the 1933 program of the Lehigh Valley, the new ballast requirements of that road for that year were reduced 25,000 tons, effecting a saving of $22,500 in stone alone.

Amount of Stone Ballast Cleaned by Various Roads From 1928 to 1933, Inclusive

	Aver. 1928-1930 inc. (track miles)		1931 (track miles)		1932 (track miles)		1933 (track miles)	
Road	Shoulder Ballast	Intertrack Ballast	Shoulder	Intertrack	Shoulder	Intertrack	Shoulder	Intertrack
A	5	50.0	4.0	194.0	—	35.0	18.0	167.0
B	—	—	—	97.0	1.0	40.0	28.0	80.0
C	20.8 (1930 only)	79.6	81.0	134.0	117.3	191.1	149.6	150.3
D	110.0	114.0	36.0	37.0	0	0	0	0
E	76.0	295.0	36.0	140.0	20.0	77.0	24.0	96.0
F	228.2	253.0	337.4	260.0	216.0	166.4	230.2	254.4
G	0	180.3	0	79.0	0	47.0	0	99.0
H	(data not available)		206.8	714.7	275.7	1,193.5	356.7	1,146.6

Most Roads Behind on Ballast Cleaning

In view of the generally recognized importance of keeping stone ballast clean, what has been the record of ballast cleaning on different roads during the last few years? In the absence of more extensive data, the facts contained in the accompanying table will show the situation on eight representative roads.

Analysis of these figures shows that, as a whole, these

*A paper prepared for presentation before the Metropolitan Track Supervisors Club of New York City on March 7.

Clean Rock Ballast Is Recognized as the Most Satisfactory for Dense Traffic Lines

roads have acted in accordance with their convictions as to the importance of cleaning ballast and, in spite of drastic reductions in appropriations for maintenance of way work generally, they cleaned 1,993 miles of inter-track and 806 miles of shoulder ballast in 1933, or more than in either 1931 or 1932, and, in fact, more than the average mileage cleaned in the relatively prosperous years of 1928, 1929 and 1930, inclusive.

These figures are impressive, but they do not mean necessarily that there is no deferred ballast cleaning on the railroads as a whole, or even on those roads that have enlarged their cleaning programs in recent years. More probable, even those roads which have carried out the largest programs could still further expand their operations to advantage, and the extent to which the different roads are behind is simply a matter of degree.

Should Cleaning Precede Track Surfacing?

It is quite obvious that no normal or average period between cleanings can be established for the railways as a whole, or, as a matter of fact, for any particular road in its entirety. The length of this period depends upon many factors, the more important of which are the density and character of the traffic, the character of fuel used, the type of subgrade, the quality of the ballast itself, and the location and gradient of the line. For those roads reporting, it appears that the interval between successive cleanings ranges from as little as one year to as much as ten years. Mr. Phillips states that the ballast on the eastern end of the Lehigh Valley requires cleaning every three or four years, while the line west of Sayre, Pa., which is largely in open country and with lighter traffic, requires cleaning only every six or seven years. On the Central region of the Pennsylvania, the cleaning periods vary from one to four years, while on the New Haven it has been found that cleaning is necessary only at intervals of from six to ten years.

Frequently, the length of the period between successive cleaning operations bears a relation to the frequency with which it is necessary to raise and surface track, because on most roads it is considered desirable to clean the ballast prior to raising. This practice, however, is not followed or considered essential by all roads. Both Mr. Phillips and Mr. Doughty point out that machine cleaning should be done in advance of raising and surfacing work to provide adequate clean stone for tamping, and to minimize the amount of time which would be required otherwise in hand forking to secure clean stone. Two other maintenance officers expressed the belief that the cleaning of the ballast ahead of out-of-surface raising and surfacing, if dirty, is essential to economical maintenance, one pointing out that this practice, along with other advantages, permits smaller raises of the track, requiring less stone.

While agreeing with the principle of cleaning prior to raising, Mr. Chinn cites his belief that, at times, due to subgrade conditions, tracks may require raising and surfacing before the ballast becomes foul, and Mr. Bartlett advises that conditions are such on his road that, quite generally, the track may be raised and surfaced two or more times between successive cleanings. Apparently influenced by the same situation as that existing on the New Haven, G. W. Harris, chief engineer of the Atchison, Topeka & Santa Fe, states that cleaning prior to raising and surfacing, while desirable, is not always essential.

How About the Crib Ballast?

Closely related to the above question is that as to whether it is desirable or essential to clean the ballast in the tie cribs. To this question the answer appears to be almost unanimously in the affirmative, although some roads admit that because of the large expense involved in this work, the crib ballast has been neglected to some extent, especially in recent years. Both Mr. Stimson and Mr. Patterson report that on their roads it is considered most important to clean the crib ballast along with the inter-track and shoulder ballast, pointing out that, otherwise, the dirt is rammed under the ties, and that under such conditions one cannot expect to maintain proper line and surface.

Mr. Bartlett considers the cleaning of the crib ballast essential to proper drainage of the track and to permit quick drying out, while Mr. Chinn is of the opinion that while it is important to clean the ballast in the cribs, this is not as important as cleaning the ballast at the ends of the ties. On the Lackawanna, according to Mr. Doughty, it has not been the practice to clean the crib

ballast where the tracks can be raised two or three inches, and on the Lehigh Valley, largely because of the expense involved, the crib ballast in recent years has been cleaned only when the track is extremely dirty or is pumping.

On all of the roads reporting, the removal of the dirty ballast from the tie cribs is done with shovels and/or ballast forks and hoes, it usually being thrown out into the inter-track space for cleaning by machine. For this laborious method of cribbing out, there appears to be but one excuse—the lack of a practical unit of mechanical equipment to do the job. However, a unit of equipment to remove dirty ballast from the cribs mechanically has been under development during the last two years, and is now said to perform satisfactorily. This machine, by means of a series of power-operated kickers, throws the ballast out of the cribs to any desired depth, all of the way to the ends of the ties. It is said that the machine can operate at the rate of more than a crib a minute.

Clean Shoulder or Inter-Track First?

The ideal practice in cleaning ballast is, unquestionably, to clean all of the ballast; that in the shoulders, in the cribs, and in the intertrack space. However, most roads have not been able to afford the ideal. Some roads, as has already been pointed out, have neglected the cleaning of the crib ballast because of the expense involved, and, quite commonly during the last two or three years, because of limited funds, it has become necessary on some roads to choose between spending such money as is available for the cleaning of the ballast, for cleaning either the intertrack ballast alone or the outside shoulder ballast alone.

With this problem comes the very practical question of which should be cleaned first, or which results in the greater benefit, cleaning the intertrack ballast or the outside shoulder ballast. On the basis of the figures of shoulder and intertrack ballast cleaned, included in the table presented above, it would seem that the answer should be generally in favor of the intertrack ballast because of the preponderance of this class of cleaning which has been done. Such, however, is not the case, although the answers are by no means unanimous.

On the Baltimore & Ohio, the Alton, the Santa Fe and at least one other large road, it is considered, as a general proposition, more important to give prior attention to the outside track shoulder, although it is recognized that local conditions often dictate that the intertrack ballast should be cleaned first. Armstrong Chinn is most positive in this regard, when stating that "if a choice has to be made, the cleaning should be done on the outside shoulder, for the reason that clean ballast here permits water to drain away from the track instead of holding it within the track limits."

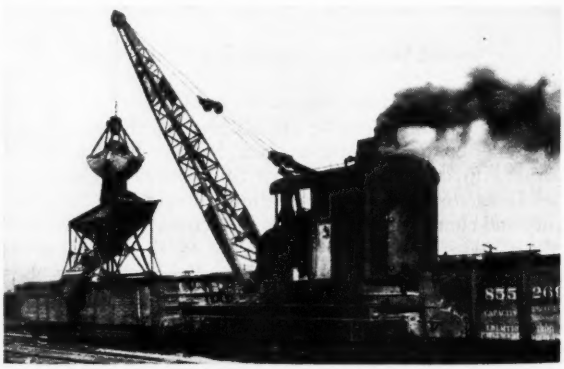
On the other hand, Mr. Patterson believes just as positively to the contrary, stating that "the center should always be cleaned first, as this provides drainage for both tracks, while the cleaning of the shoulder will provide drainage for only one track." Mr. Bartlett and several others uphold Mr. Patterson's contention and point out that dirty shoulder ballast will, of itself, drain with greater facility than dirty intertrack ballast. Mr. Bartlett also believes that if the intertrack ballast is cleaned, the inner portions of the tracks will dry out as quickly as the shoulders. One chief maintenance officer has figured that of the total volume of water that falls on double track, from ballast margin to ballast margin, approximately 53 per cent drains into the center ditch and 23.5 per cent to each outside shoulder or side ditch. Therefore, he contends that it is more important to keep the center ditch clean, so that the water may drain along the center ditch to cross drains, and thence to the side ditches. Mr. Phillips also prefers, as a general rule, to clean the intertrack ballast first, although he makes it clear that track conditions in each locality must govern.

Early Methods of Cleaning Were Costly

From the foregoing it is evident that with the use of crushed stone for ballast came the problem of cleaning it. The earliest method of cleaning was with ballast forks, a method which is still used to a limited extent. To cut down the cost of fork cleaning, speed up production and increase the efficiency of the cleaning, a number of roads have used different forms of inclined portable screens set up along the track, against which the dirty ballast was thrown. As this was obviously not the solution, certain railway supply companies studied the problem of applying power to the task. Possibly the most serious early attempt in this direction was the Harris-Muff machine, which was a track-mounted unit with a power-operated conveyor belt moving through a relatively long trough, into which the dirty ballast was thrown by hand from each side. At the end of the belt the ballast fell over a screen, the stone returning to the track and the dirt being conveyed laterally to the shoulder on a second endless belt. The fundamental weakness of this machine was in the fact that it required the manual handling of all of the ballast to be cleaned. That this deficiency was recognized is evidenced by the fact that all subsequent attempts to clean ballast with power equipment have been predicated on the requirement of minimizing manual labor.

Cranes and Screens Were Used Extensively

Modern methods of cleaning stone ballast involve the use of equipment, all types of which handle the ballast mechanically. These machines include the McWilliams intertrack and border "moles"; the Brownhoist ballast



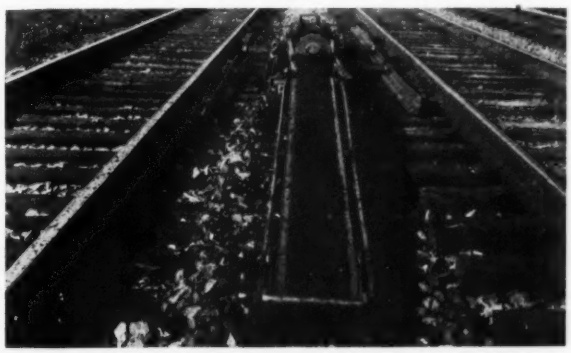
Locomotive Cranes, With Clam Shell Buckets and Screening Equipment, Have Been Used Extensively for Cleaning Ballast

cleaner; the Speno ballast cleaning machine; the Fairmont ballast cleaner; and locomotive and ditcher cranes used in conjunction with clamshell buckets and screens, stationary or vibrating, mounted on top of open-top cars, sometimes equipped with screen-feeding hoppers. The last mentioned method, once predominating on certain of the larger roads, has since been largely superseded by the use of one or another of the machines designed specifically for cleaning ballast, although it is still used to a considerable extent on two or three roads.

In this method, individual cranes are usually employed

between pairs of screen cars, to which they are coupled. Two or more of these groups are usually worked together on the same track to minimize interference with revenue traffic. Usually, the assembled equipment is accompanied by a road locomotive, which is used to take it on and off the main line, coupled together as a work train.

This method of cleaning is so much more economical and effective than earlier methods, and offers such largely increased production over these methods, that it proved a boon to many roads, which, for lack of more suitable equipment, had fallen behind in their ballast cleaning work. However, this method ties up the cranes at the



The Conveyor of the Inter-Track Mole Which Carries the Dirt to the Shoulder Can Be Readily Swung Into the Clear as Shown

height of the general working season when they are required for other work, while they require a relatively large amount of work-train service for the production secured, ranging from 1,700 to 2,000 lin. ft. of intertrack space a day.

As regards this latter point, Mr. Phillips, speaking of the experience of the Lehigh Valley, reports, in part, as follows: "The Lehigh Valley employed 738 work trains on current maintenance work in 1930, while in 1932 it used only 107 such trains on the same classes of work; a reduction of 631 work trains, equivalent to approximately $56,800, for which its present method of cleaning ballast is responsible to a large extent."

Many "Moles" in Use

The McWilliams "mole," built by the Railway Maintenance Corporation, was one of the earliest and most widely accepted modern ballast cleaning machines. In fact, it is said by the builder of the machines that there are at present 168 moles on 14 different roads, two of which roads have 33 or more units.

The intertrack mole, which was introduced in 1926, is a gasoline-operated self-propelled machine, which operates in and longitudinally through the ballast between tie ends in double or multiple track territory, digging its own way, screening the ballast, and returning the clean stone to the roadbed while conveying the dirt removed to the track shoulder. Essentially, the machine consists of a steel frame, with suitable mechanism at the front end to break down and conduct the ballast to the machine; an endless belt conveyor which carries the ballast longitudinally back over the frame; a reciprocating screen which agitates the ballast, separating the dirt from it; and a second endless belt conveyor, power-operated, which can be swung through 180 deg. across adjacent tracks for delivering the dirt to either side of the roadway, as desired.

The machine propels itself through the ballast by means of power-operated toothed wheels which ride on and engage a rack laid along the tie ends of adjacent tracks. The power plant for all of the functions of the machine is located in the center portion of the frame, between the upper and lower planes of travel of the ballast conveyor belt.

The border mole is distinctly an adaptation of the principles involved in the intertrack mole. This unit moves along the ballast shoulder at the depth of cleaning desired, separating the dirt from the stone and placing the cleaned stone back in the track in the same relative position that it was before it was disturbed.

Entirely aside from the efficiency of the moles, both from the standpoint of effectiveness and low cost production, is the advantage which they have in working without obstructing the track. They, of course, suffer some interruption from passing trains, but the machines themselves do not interfere with traffic.

Roads using the moles, either in whole or in part, for their ballast cleaning work, report that the depth of cleaning ranges from 8 in. to 12 in. below the bottom of the ties, with the most generally adopted depth of 10 in. The speed with which the moles operate varies quite widely, ranging from about 700 lin. ft. to around 1,200 lin. ft. per eight-hour day for the inter-track moles, and from about 850 to 1,200 lin. ft. in the same period for the border moles.

Brownhoist Machine Employs Buckets

The Brownhoist ballast cleaning machine, developed by the Industrial Brownhoist Corporation, consists of two main units, one for excavating and hoisting the dirty ballast and the other for screening the ballast. Each of these units is mounted on a steel car frame, the cars being coupled together to form the unit.

All ballast is excavated by two clamshell buckets. These buckets, which are spaced about 15 ft. center to center, and are capable of excavating to a maximum

The Brownhoist Ballast Cleaner

depth of 24 in. below the base of the ties, operate in curved channel guides which direct them over the center of the car in an upward movement, and which prevent them from swinging beyond the midpoint of the intertrack space when in the lowered position. Between the buckets there is a plow which can be raised and lowered on guides, which is designed to push the ballast from the far half of the inter-track space to a point within the reach of the rear bucket.

Directly beneath the buckets in their raised positions over the center of the car are receiving hoppers, underneath which an apron conveyor transports the dirty ballast to the rear of the car. At this point, the ballast is dumped into a hopper which feeds an apron conveyor on the screening car unit which, in turn, carries the ballast to vibrating screens for separating out the refuse. From the screens the refuse is dumped into a dirt chute, from which it is carried by another conveyor to the rear

end of the second car, while the cleaned ballast is dropped into a hopper beneath the screens, preparatory to redistribution in the track. The refuse screened from the ballast is disposed of either over the track shoulder or into dirt cars coupled behind the cleaning equipment. This is made possible through the provision of a boom loader, which can be swung through 180 deg. at the rear of the screening car. If the refuse is to be disposed of in cars, it is conveyed by the loader to a receiving hopper of a belt conveyor line which extends over the refuse cars.

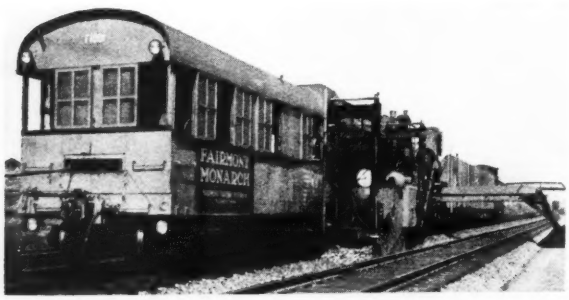
The complete ballast cleaning outfit, together with the dirt cars, is moved to the site of the work by a locomotive, after which the locomotive acts as a "dead man" in advance of the equipment, and the equipment moves itself forward as desired by means of an electric haulage unit mounted on the front end of the excavating car. Power for the operation of all of the equipment on the ballast cleaner is supplied by a gasoline engine-generator set.

Two of the Brownhoist machines have been employed in extensive ballast cleaning operations on one road during recent years, where they have cleaned approximately 7,100 lin. ft. of inter-track a day to a depth of 16 to 18 in. below the bottom of the ties.

Fairmont Machine Also Has Large Production

The Fairmont ballast cleaner, which has been developed by Fairmont Railways Motors, Inc., was first used in 1931. Somewhat altered and refined in design, this machine was operated on a contract basis to a considerable extent during 1933.

This machine is a specially built all-steel car, 65 ft. long, designed to plow up the ballast along each side of the track, screen it, return the cleaned stone to the roadbed and dispose of the dirt. It will work on either



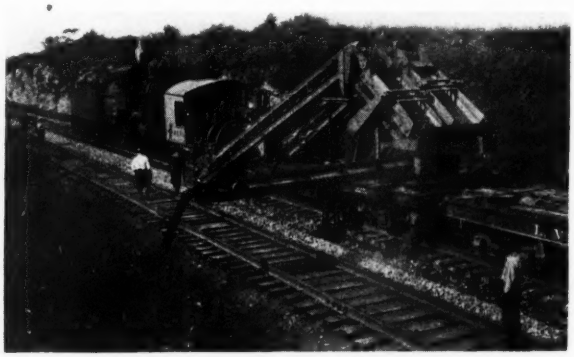
The Fairmont Ballast Cleaner

single or multiple track, cleaning one or both shoulders, one shoulder and one intertrack space, or the ballast in two intertrack spaces simultaneously, if desired.

In this unit, all of the equipment for picking up the ballast and cleaning it is housed in two 15-ton steel boxes, mounted on each side of the car in such manner that they can be swung out quickly and lowered into position for operation, or drawn in flush with the sides of the car to clear trains on adjacent tracks when this becomes necessary.

The boxes are equipped at the front with two heavily reinforced wings, which are spread or drawn in by means of hydraulic cylinders. When the boxes are let down into the ballast, which is possible to a depth of 18 in. below the base of the ties, the wings dig into the ballast as the car moves forward, forcing the ballast into the box where conveyors carry it up over a series of screens. Here, the ballast is agitated, the dirt dropping down on to another conveyor, while the cleaned stone is carried back to the rear of the box where it is distributed to the track and left shaped to standard section. By means of the dirt conveyor, which can be swung about a fixed point beneath a dirt hopper, the refuse from the ballast can either be deposited over the roadbed shoulder or delivered to a two-car dirt unit coupled behind the machine, in which a two-way dragline scraper is used to distribute the dirt, or, later, to unload it.

When the cars are full, the cleaner train moves ahead to the nearest point where dumping over the shoulder is permissible, and resumes cleaning while the emptying of



The Speno Machine in Operation

the cars is under way. Unloading is done by the dragline scraper operating in the reverse direction, which moves the dirt forward and on to the same conveyor belt which ordinarily carries the dirt directly to the track shoulder.

The various moving parts of the machine are driven by electric motors, which receive current from an electric generator driven by a gasoline engine. The machine as a whole pulls itself along the track, using a locomotive as a movable anchorage ahead. In the work done with the machine during 1933, two gas-electric locomotives were used for this purpose. These would move ahead on the track, set their brakes, and the cleaner would then pull itself up to them by means of a steel cable operated over a power drum in the engine-generator cab of the unit.

The speed with which the machine moves through the ballast and the amount of ballast cleaned in a day varies with conditions. The average production of the machine during its 1933 operation on one large road is reported to have been approximately 7,200 lin. ft. of intertrack, plus about half as much shoulder.

Speno Machine Has Large Output

The Speno ballast cleaning machine, which was developed in 1929 by Frank Speno, is a flat-car-mounted unit, consisting essentially of a twin arrangement of scoops, belt conveyors, vibrating screens, ballast chutes and scrapers, one on each side of the car, and a single pivoted boom conveyor for the discharge of the refuse screened from the ballast.

The two screening arrangements operate independently of each other and are provided so that the machine can clean the ballast on either side of the track, or on both sides simultaneously, if desired. The scoop, when in its lowered position, picks up a swath of ballast 29 in. wide and of uniform depth, which is deposited on an elevating belt conveyor fixed rigidly within the scoop, which, in turn, conveys the ballast to a longer elevating

belt conveyor. This latter conveyor is inclined inward toward the center of the car at the rear and carries the dirty ballast to the top of an inclined vibrating screen. After passing over the screen, the clean ballast drops into a hopper with discharge chutes, from which it can be delivered either to the intertrack space or between the rails. The dirt screened from the ballast falls into a large open-bottom hopper, and from thence on to the dirt belt conveyor, which is pivoted at its inner end so that it can be swung to either side of the car for discharge over the roadway shoulder, or directly to the rear for discharge into refuse cars.

The machine can be continued in operation while trains are passing on an adjacent track if the track centers are 12 ft. 8 in. or more, and the scoops can be pulled up quickly, bringing them entirely within the side limits of the car when it is desired to clear traffic or to move the machine over the road.

Two of the Speno machines, working under contract, have cleaned a large mileage on two roads in the East. In this work, they were pulled over the track by a steam or gas-electric locomotive. On both roads, the cleaning was done to a depth of 8 to 10 in. below the base of the ties, and the equipment was moved over the track at an average speed of about one mile an hour.

The Speno machine makes three passes over the intertrack space or two passes over the track shoulder. The road using the Speno machine to the greatest extent reports that, in an eight-hour day, it completely cleans two intertrack spaces or one intertrack space and an outside shoulder, for a distance of about two miles.

Other Machines of Interest

In addition to the machines already mentioned, two others, while not ballast cleaning machines in the sense that they pick up, agitate and remove the dirt throughout the depth of the ballast, are worthy of mention. These machines are the sweeper and the sucker developed by and used on the Pennsylvania to remove surface cinders and other fouling material from the track, and, thereby, to lengthen the intervals at which it is necessary to clean the ballast throughout.

The track sweeper is a power-driven unit, consisting essentially of a rotary steel broom which is suspended beneath the frame of the car. The broom, which can be raised and lowered at will, sweeps the dirt on to a steel pan attached just ahead of it, through which the dirt is guided to a wide conveyor belt on which it is carried to a hopper just above and ahead of the broom. From this hopper the dirt is discharged upon another conveyor belt mounted in an extension boom, by means of which it is carried to a gondola car coupled to the sweeper. Ordinarily, the machine is operated over the track at the rate of about four miles an hour.

The sucker, which operates on the principle of a steam siphon with steam obtained from the work-train locomotive which pushes it over the track, consists essentially of a flat car on which are mounted a series of seven eight-inch pipes, which span the width of the track and lead from the surface of the ties up and back over the end of the flat car into a covered hopper car coupled to the flat car. Steam blown into the upper ends of these pipes creates a vacuum in the lower ends sufficient to draw up the dirt from the track and discharge it into the adjacent hopper car. This unit of equipment, which, like the sweeper, is designed to remove only surface accumulations of cinders, engine sparks, coal dust, etc., is operated at a speed of about four miles an hour.

While not a ballast cleaner in any sense of the word, the Fairmont ballast plow or scarifier, built by Fairmont Railway Motors, Inc., is reported by Mr. Harris as having been used to advantage on the Santa Fe in breaking up the cementing tendency of the limestone ballast used on that road, improving track drainage conditions materially. Two of these machines were operated over several hundred miles of track on various parts of the Santa Fe during 1933.

Much Ballast Cleaning to Be Done

What are the prospects for ballast cleaning during 1934 and 1935? Judging from the desires and plans of the maintenance officers questioned, the next two years will witness the cleaning of more ballast than any previous years. Most roads have never been able to keep pace with the rate at which their tracks are fouled, let alone catch up on the ballast cleaning which should have been done in past years. Thus, it is not surprising that road after road has reported that it will maintain or expand its ballast cleaning during the next two years if business conditions permit.

Less Machines and More Men

(Continued from page 140)

sheer weight of its own unsatisfactory record, will eventually succumb to the competition of a better device.

While there is no economic justification for the use of any appliance that cannot do work for less money than it can be done by hand, taking into account all of the items of expense incident to its ownership and operation, it is necessary in some instances to give weight to a further factor, the quality of the work done. This factor may introduce either a favorable or an unfavorable influence but it should be given due weight. In some cases it is theoretically possible to do just as good or even better work by hand than with a power tool or machine, but the hand work is so arduous that the human factor is almost certain to assert itself in efforts to obtain quality results. Typical examples of this are to be found in riveting, mixing concrete, tamping ties and in cleaning metal surfaces for repainting, all of which involve such hard or tedious work, if done by hand, that the quality suffers with increasing fatigue and dragging hours.

Eliminating the Drudgery

While the influence of fatigue on quality of output is of minor importance in most classes of work, advocates of the use of mechanical equipment point to the effect of the mechanization of maintenance of way work in removing much of the drudgery formerly involved in work on the tracks and structures. In considering this aspect of the application of power tools, it is necessary to bear in mind that there are those who have grave doubts concerning the beneficial effect of mechanization, in so far as it concerns the worker's enjoyment of his daily tasks.

It is contended, for example, that a man can derive more pleasure from making a good pair of shoes by hand than he can hope to get in tending a machine that performs the single operation of inserting eyelets. But does this apply to work on track and bridges? Is there a man who would not rather ride in a motor car than pump a hand car, or who has any regrets because most of the heavy lifting is now done by cranes? The operation of a mechanical tamping tool may be monotonous, but is it more so than tamping with a pick and is it not less fatiguing? A power saw used in bridge work consumes far less human energy than a hand saw, and because it works

so much faster, the carpenter is enabled to spend more of his working hours at less monotonous tasks.

While mechanization in industry at large has greatly increased the monotony of labor, thus far, at least, it has not resulted in any appreciable reduction in the variety of tasks assigned to the individual workman on railway tracks and structures. Rather than decreasing his opportunities for self-expression in his tasks, it has done much to stimulate mechanical skill and pride in his work.

Reference was made earlier in this article to the efforts extended by the federal government to stimulate employment. This might lead to the conclusion that the administration is inclined to discourage the application of labor-saving equipment, but there is little ground for this view. For example, the part of the National Industrial Recovery Act relating to public works states that "the maximum of human labor shall be used in lieu of machinery," but abridges this mandate by adding, "whenever practicable and consistent with sound economy and public advantage." The publisher of a leading Washington news service has stated that "Labor-saving machinery and equipment are not frowned on by the N.R.A., are theoretically encouraged." This view is also expressed succinctly by an officer of the P.W.A. in a letter in which he states that "You are advised that this administration favors the use of hand labor wherever possible in connection with the Public Works projects. This does not mean, however, that hand labor should be used at the expense of efficiency." In the same vein, General Hugh S. Johnson, Administrator of the N.R.A., is on record as favoring efforts to stimulate the manufacture of machinery "required by mills and factories and our transportation system for fully efficient operation under today's conditions."

Equally specific is a statement from Joseph B. Eastman, federal coordinator of transportation that "I have no authority under the Emergency Railroad Transportation Act, 1933, to interfere with economies of railroad operation effected by individual railroads in ordinary course of management. I have been importuned on one or two occasions to use my influence to discourage the introduction of labor-saving machinery by individual railroads, but have declined to accede to such requests."

Quality or Price in Tools?

(Continued from page 143)

the basis of quality or of price and, if the latter, what maintenance officers are doing about it. In other words, are they doing as Mark Twain suggested about the weather—merely talking but doing nothing about it—or insisting on getting the grade of tools that they believe best suited for their conditions?

It is apparent from the replies that the officers of the maintenance of way department are alert to press their needs with respect to tools. In fact, it appears that on most roads the purchasing department is receptive to their demands. On one road in particular, "price is usually given no consideration, since the purchasing department is not permitted to make substitutions of any kind of tools without the authority of the engineer maintenance of way." On another, "the purchasing department is sympathetic to our efforts to secure the best tools available."

An example of the working arrangement between the two departments was outlined for one road on which "it has been our practice to purchase tools of demonstrated merit, and we keep the purchasing department advised of our preference and the reasons therefor. This department very properly brings to our attention from time to time the comparative prices of the various grades of tools and suggests the use of those of lower price, if they are considered satisfactory. It does not insist on supplying the tools merely on the basis of low price, but is guided by the recommendation of the heads of the departments where they are to be used."

With respect to water service tools, "I have never hesitated to order the best tools available regardless of price, and by giving complete catalog reference I have always been able to secure what was ordered," was the comment of the head of this department on a large road.

As against this, several replies indicated that the purchasing departments on some roads are not entirely sympathetic with the efforts that are being made to keep the forces equipped with quality tools and that "we are constantly on the lookout for tools of inferior design and quality, and endeavor to eliminate them. The purchasing department considers that it is its duty to fill all requirements as cheaply as possible, so that price is an important consideration. I do not believe, however, that any purchasing department is blind to quality or desires to buy tools that will lower the output and quality of work, or that will contribute to accidents."

On another road, it was stated that "the purchasing department is not always sympathetic, and it is necessary for us to repeat from time to time an active campaign for quality tools, or cheap tools will be furnished. Our insistence on this point has borne fruit, with the result that we are getting a distinctly better grade of tools and the improvement in service has been marked."

One roadmaster writes "I keep informed on new and better tools through advertising and reading matter in publications devoted to these matters. I frequently ask for trial orders of tools that I believe will be of benefit. So far, I have been able to interest both the head of the department and the purchasing agent and in many instances the results have been satisfactory."

Although the responsibility for convincing railway managements that good tools are an asset and poor tools a liability, falls directly on the shoulders of maintenance officers, manufacturers of quality tools are not without responsibility in the matter. Obviously, on a road that habitually buys tools on price, the maintenance officers are at a serious disadvantage in pleading their case, since they are not able to speak from experience. On other roads where purchases are frequently made on this basis, the disadvantage is a matter of degree. Even on those roads where good tools are used regularly, it is often difficult to convince purchasing officers that quality tools have an economic value that overshadows the difference in cost between these tools and those that other roads may be buying more cheaply. Whatever the attitude of purchasing officers, manufacturers owe it to themselves to see that maintenance officers are in possession of reliable information concerning the economic and other benefits that come from the use of quality tools.

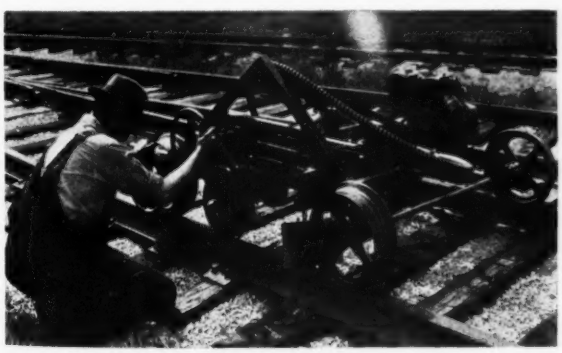
From the foregoing it is evident that there is a real difference in the quality of the tools that are on the market. It is equally apparent that maintenance of way officers of all grades have found from experience that there is no economy in the use of tools that are sold on price without demonstrating quality. Furthermore, the examples and comments that have been presented, while typical, by no means exhaust the list of those that might have been given. They were withheld merely to avoid repetition. Ample evidence has been presented to show that as the quality of tools is degraded, there is a falling off in the quantity of work done as well as in the quality, while the morale of the men is lowered and the accident rate is accelerated.

New and Improved Devices

Nordberg Improves Rail and Cross Grinders

DURING the past year the Nordberg Manufacturing Company, Milwaukee, Wis., has made a number of improvements in its rail and cross grinders, both of which were described in *Railway Engineering and Maintenance* for March, 1932. In the rail grinder, the main frame has been reinforced and braced and a new type motor has been installed. Heavy duty ball bearings of larger size have been incorporated in the main shaft and spindle drive. The diameter of the emery wheel spindle has been increased from 1 in. to 1¼ in. and the diameter of the grinding wheel has been increased from 10 in. to 12 in. As an aid in transferring the machine to and from the track, steel lifting handles have been added at convenient points.

To eliminate a kink in the flexible shaft of the cross grinder with which this machine is equipped, the power takeoff of the shaft has been placed at right angles to the main drive shaft, permitting the flexible shaft to lead from the machine in a direction parallel with the rails. Also, an overload release has been incorporated in the power takeoff of the flexible shaft which protects the shaft in case the emery wheel should become snagged during the slotting operation. The flexible shaft is also equipped with a clutch which permits the drive of the



The Improved Nordberg Rail Grinder

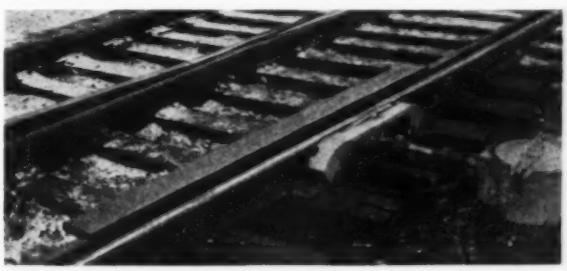
cross grinder to be disconnected instantly. The engine has been equipped with a convenient governor control which permits the speed of the emery wheel to be maintained at a constant rate as its diameter is reduced by wear.

The Nordberg cross grinder has been equipped with a new type flexible shaft which is said to be stronger and more durable than the shaft formerly used. The new shaft has a completely armored casing, with an oil and abrasion-resisting rubber coating. The end pieces are completely enclosed and require lubrication only every six months. The cross grinder on the rail grinder has also been equipped with the improved Nordberg flexible shaft.

An improved slotting grinder with a swinging action has been developed for the cross grinder unit, which is said to be faster and to assure greater accuracy for slotting and beveling rail ends than the original guide. The cup wheel drive used in connection with the cross grinder for dressing stock rails and switch points has also been strengthened and improved.

Rail and Flange Lubricator Now Used on Guard Rails

THE Maintenance Equipment Company, Chicago, has adapted its Meco rail and flange lubricator to the lubrication of the wearing surfaces of guard rails on long curves to reduce the wear on these rails. The Meco rail and flange lubricator was originally designed to pro-



View of an Installation of the Guard Rail Lubricator

tect the high rails of curves against flange wear and nearly 1,200 of these lubricators are now in service on more than 60 railroads.

For application to guard rails, the actuating and pumping mechanism of the lubricator are the same as for the lubrication of the running rail. The lubricant-distributing plate is applied directly upon the top of the guard rail, by means of angles bolted to the web of the rail. The device may be applied to all types of guard rails. It may be installed at the entering end of the guard rail to be lubricated, or on a short auxiliary guard rail placed just in advance of the guard rail to be protected.

As the tread of each car wheel passes over the actuating ramp of the lubricator, lubricant in paste form is forced through eight orifices in the distributing bar onto the back of the wheel flange, from which it is distributed to the bearing surface of the guard rail. The edge of the distributing bar is set back slightly from the face of the guard rail so that there is no contact between the

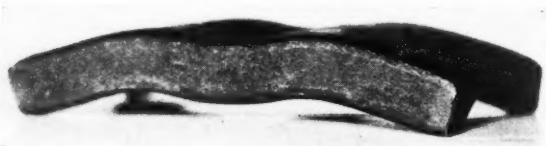
bar and the back of the wheel. The same graphite paste lubricants are used in the guard rail lubricator as in the running rail lubricator. These lubricants are said to function satisfactorily through temperature ranges of from at least 10 deg. F. below zero to at least 110 deg. above zero.

Lubrication of the guard rail is said virtually to eliminate wear due to flange friction and to minimize derailment hazards.

Triflex Springs Now Available in Two Bolt Tensions

THE Triflex Spring for track bolts, manufactured by the Woodings-Verona Tool Works, Verona, Pa., has now been made available with a bolt tension of 15,000 lb. as well as with the bolt tension of 18,000 lb. originally provided, as described in the June, 1932, issue of *Railway Engineering and Maintenance*. This spring consists of a high-carbon forging having a channel section shaped in the form of a flat arch with a short reverse curve at the crown.

The original spring developed a tension of about



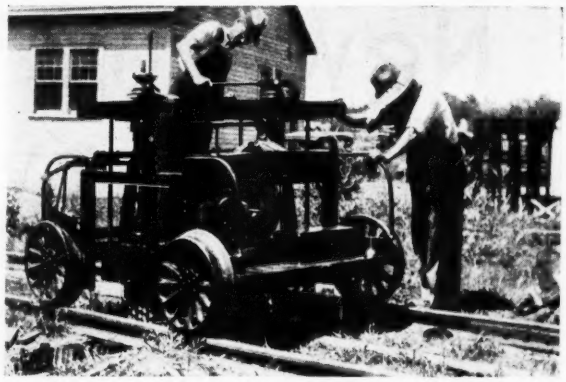
The Woodings-Verona Triflex Spring

18,000 lb. in the bolt when the convex curve of the spring was brought into contact with the joint bar. The desirability of making this spring available also in a lower bolt tension became apparent for several reasons. Some maintenance officers feel that a bolt tension of 18,000 lb. is too high, a fact brought out in an investigation made recently by the Committee on Track of the American Railway Engineering Association in an effort to determine the desirable tightness of joints. Another reason for developing a Triflex spring offering a lower reaction was that in applying the 18,000-lb. spring, some trackmen are prone to stop wrenching before the center of the spring touches the angle bar, a condition which sets up unequal tension in the bolts and fails to develop the full reaction which the spring is designed to produce.

Tie Cutting Machine Developed by Woolery

THE removal of rail-cut ties from track without lifting the track may be accomplished quickly and easily by a new machine developed for this purpose by the Woolery Machine Company, Minneapolis, Minn., which cuts the ties off adjacent to the inside of each rail at the rate of a tie a minute. The cutting is done simultaneously by two sets of six overlapping drill bits each of which is operated through a train of gears by a four-cylinder engine. The entire assembly is mounted on a four-wheel car having a frame of channel steel construction and ball-bearing axles, which may be towed by a motor car.

The power plant and boring heads comprise an assembly unit which is raised and lowered by power, a quick return bringing the bits to the raised position after the tie has been cut through. The machine is operated by



The New Woolery Tie Cutting Machine

three men, one of whom handles the raising and lowering clutches while the other two adjust the clamp that holds the machine down during the boring operation and push the car from tie to tie. The cutters are removable and may be sharpened on a grinder.

This machine weighs about 1,800 lb. and can be removed from the track at highway crossings by the three operators, being provided with extension handles that enable two men to lift one end.

Westinghouse Flexarc Welders

WESTINGHOUSE Flexarc welders, mounted on portable rail cars and available in three different combinations of equipment, comprise a new development of the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. In each case the unit consists of a 300-amp., 40-volt Flexarc welder powered with a six-cylinder Buda gasoline engine and mounted on a four-wheel rail car of substantial construction.

One of the units is self-propelled and capable of a speed of 30 miles an hour. This outfit is equipped with

The Self-Propelled Westinghouse Flexarc Welder

a 7½-kw., 125-volt auxiliary power generator to supply current for motor-operated tools, such as rail grinders, slotters and drills. It is also provided with a hand-operated device to lower transverse rollers for derailing the equipment. In the upper portion of the housing, storage space is provided for tools and accessories.

Another of the units is the same as that described

above, with the exception that it is not self-propelled, being mounted on a trailer. In addition, unlike the first welder, this unit is provided with brackets fastened to the top of the housing for carrying the combination derailing device and collapsible setoff.

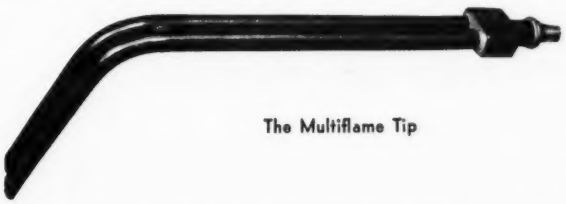
The generating equipment in the third unit, which is also mounted on a trailer, differs from that in the other

The Trailer Type Flexarc Welder Without the Welding Generator

two welders to the extent that it does not have an auxiliary generator. The lifting device for use in derailing this unit embodies the use of hand-operated jacks, whereas in the other welders the lifting device is actuated by a hand-wheel located at one end of the car.

Aircowelding and New Multiflame Tip Speed Rail Welding

AFTER extended laboratory and field tests, the Air Reduction Sales Company, New York, has adapted to rail-end welding a process known as Aircowelding, which has already been used successfully for several years in other classes of oxy-acetylene fusion welding,



The Multiflame Tip

and is said to result in a marked saving in time, labor and material. To effect a greater saving in time in building up rail ends, this company has developed a new two-flame welding tip, which, in combination with the Aircowelding process of applying the weld metal, is said to reduce by 40 to 50 per cent the labor and gas consumption used in the ordinary oxy-acetylene puddle weld process.

The fundamental difference between Aircowelding and puddle welding is the fact that in Aircowelding there is no puddling of the base metal to secure a bond between it and the added metal. In Aircowelding, only the surface of the base metal, to the extent of a thin veneer over the weld area, is brought to a molten or fusing state when the weld metal is added. This minimizes the time required to heat the base metal, and also the penetration of the heat into this metal, saving both in gases and in labor. A further saving in labor is effected because in this process the rod metal is merely flowed on in a broad bead, and requires a minimum of peening and flatter application, and a minimum of grinding, if any grinding is considered necessary.

A slightly carburizing flame is used in Aircowelding. The first operation in making a weld by this process is to preheat the entire area to be welded to a dull red only. Immediately following this, the torch is applied to start the weld, and the weld metal is applied just as soon as a sweating action is observed on the surface of the base metal. This is most important to the process, and throughout the entire laying down of the bead this sweating action must precede it. This is effected automatically by proper handling of the torch and the rod, so that a portion of the flame heats the base metal ahead of the advancing bead.

The procedure followed in the Aircowelding process of building up a rail end is, while facing the rail end to be welded, to start on the end of the rail, on the left side, and to proceed back to the predetermined limit of the batter. Then, if this first bead does not bring the rail end to proper height, a second bead is laid directly

The Aircowelding of Rail Ends is Said to Save Considerable in Gases and Labor

over it, the purpose being to establish the full height of weld required in the first bead line, and then to use this as a guide in making the remainder of the weld at the rail end.

The next bead is laid parallel with the first, beginning at the end of the rail. When the limit of batter is reached, the direction of the welding is reversed back to the rail end. Proceeding in this manner, always paying strict attention to the sweating action of the metal, the weld is completed.

Immediately following the application of the weld metal, the surface of the weld is smoothed down with the flame just enough to remove all laps and rough spots. It is said that with a little experience a welder can flow the added material so smoothly and evenly that very little grinding or flatter work is required to make a finished surface. The final operations are to trim off any overhangs with a hot cutter and to work in the edges with the flatter.

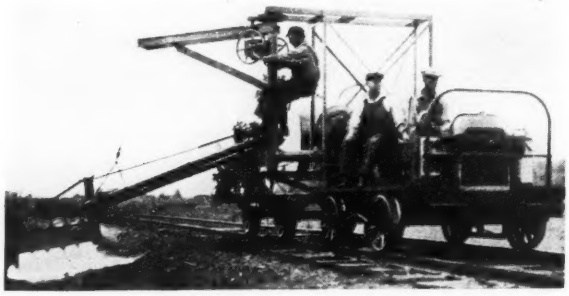
Depending upon the size of the welding tip and the size of the welding rod used, the bead applied in Aircowelding will range from ½ in. to 1 in. wide. To further increase this width, and thereby the speed of welding, the Air Reduction Company has developed a two-flame tip, which permits the welder to carry a bead 2 in. or more in width without difficulty. This new tip, which is called the Multiflame tip, is essentially two

standard single tips, side by side, with a common gas-distributing chamber and common gas feed lines. It is said that, using the Multiflame tip and a rod of proper width, or two rods tack welded side by side, a welder can make flatter-finish welds on the ends of 130-lb. rails at the rate of one lineal inch of the rail head per minute, and grinder-finish welds on the same weight rail, at an even greater speed.

The effectiveness of the welds made according to this process has been demonstrated by the experience of several roads, on which many of these welds have been in service for a period as long as a year. Most of the welds have been heat treated, and in heat treating, the new Multiflame tip, with its increased heat flow, is equally as effective in speeding up the work as in the making of the welds themselves.

A New Weed Burner

A NEW weed burner embodying a hood on an extension arm, which is designed to burn all weeds in a strip 38 ft. wide on level track in four round trips and which is provided with vertical adjustments for burning weeds on side slopes and ditches, has been developed by Fairmont Railway Motors, Inc., Fairmont, Minn. This machine, which is known as Model T29, is mounted on a trailer and may be towed by any suitable motor car. It burns a strip 5½ ft. wide on one side at a time and burns anywhere in a strip 19 ft. wide on each side of the center line.



The Fairmont T29 Weed Burner in Operation

The burner hood, which is equipped with five burners, is 3 ft. by 4½ ft. in plan, with a burning area 4 ft. by 5½ ft. under average conditions, which increases to 4½ ft. by 6 ft. as a maximum. Through an arrangement of pipes and elbows, the burner hood is fastened to the end of a swing arm which permits considerable flexibility in both horizontal and vertical adjustment. The horizontal swing, which permits the burner to be moved through an angle of 200 deg., and the vertical swing, from 15 deg. above horizontal to 45 deg. below, are controlled by two 13-in. handwheels.

The burner head can be tilted, independently of the swing arm, within a range of 60 deg. above to 45 deg. below the horizontal by a screw and nut support rod with a crank handle. Regardless of the angle that the swing arm makes with the track, the burner arm may be adjusted to remain at right angles to the track. The seat is mounted on and moves with the swing arm so that the burners are always in front of the operator.

A noteworthy feature of this burner is the fact that the entire superstructure is pivoted on the trailer truck so that two men, by removing four bolts, can turn the superstructure 180 deg. for burning on the other side of the track. The motor car operator and one operator for the burner comprise the only labor required to operate this equipment.

Cooling of the hood and burners and preheating of the air blast from the pressure blower, this air being transmitted through the two pipes forming the swing arm, are accomplished by forcing the air blast through a labyrinth of air passages in the hood in each side of the row of five burners. Thus the air is preheated before it is mixed with the fuel and at the same time the hood and the mechanical parts of the burners are protected from overheating.

The burner is powered with a Fairmont QE engine, capable of developing more than 11 brake horsepower. The fuel tank, which has a capacity of 450 gal., is electrically welded to that part of the frame on which it rests. Strained oil under pressure is delivered to the atomizer nozzle in each of the burners by a fuel pump which is connected by means of a V-belt to the blower shaft.

The T29 weed burner is designed primarily for operation on districts of 150 to 300 miles of track, which it can cover while the weeds on the ballast section are still small and may be burned at low cost.

Transite Pipe for Many Services

THE Johns-Manville Company is now marketing a complete line of Transite pipe in sizes ranging from 2 in. to 36 in., inside diameter, designed for carrying practically every kind of gas or liquid under pressure up to 217 lb. per. sq. in., or its equivalent head or 500 ft. of water. It is said that the new pipe, numerous installations of which have already been made, has qualities which adapt it particularly for use as flues, stacks and vents carrying either hot or cold gases, and for practically any class of water service lines.

Transite pipe is composed of asbestos fibre and Portland cement, combined under pressure into a dense, homogeneous structure, and is said to possess high strength and unusual resistance to destructive agencies.

A Transite Pipe Installation Under Way at a Railroad Terminal

It is made in seven classes, F, S, A, B, C, D and E, for different sizes and services, and suitable couplings and fittings are available for all of these different sizes and classes of service.

Class F pipe, which is furnished for pipe ranging from 2 in. to 12 in. in diameter, is not designed to withstand pressure but is intended for flue pipes, vents and similar

uses. Class S pipe, which is furnished in sizes up to 36 in. in diameter, is designed for internal pressures varying from zero to 21 lb. per sq. in. and is intended largely for carrying gases or liquids at little or no pressure, such as flues, stacks, gutters and downspouts, hot air heating ducts, fire protection for electric cables, and drainage or soil lines.

Classes A, B, C, D and E Transite pipe are pressure classes, designed for working pressures of 43, 86, 130, 173 and 217 lb. per sq. in., respectively. They are intended to meet the requirements of water supply and distribution mains, soil lines, drainage systems, culverts and large stacks. Class F pipe is furnished in lengths of 5 ft. or 6 ft. 6 in., depending upon the diameter, while all of the other classes are furnished in lengths of either 10 ft. or 13 ft., the longer lengths being in the larger diameters.

Because of its composition, Transite pipe is said not to tuberculate and to be immune to soil corrosion and is not subject to electrolysis. Owing to its light weight, it is said to be easier to handle and install, and it increases in strength with age. For water transportation, its smooth interior surface gives it a high delivery capacity.

Several types of couplings are available for use with the pipe. For underground service the Simplex coupling, consisting of a Transite sleeve and two rubber rings, is most widely used because of its flexibility and because it remains tight even under severe vibration. Other types of couplings suitable for use with the pipe, especially above ground, are the Dresser, Dayton, and a special flanged coupling. Metal fittings and accessories of practically any type can be introduced readily into any Transite line by the use of an adapter.

New Flexible Pipe Coupling

A NEW type of threadless flexible pipe coupling, which is said to be applicable to a wide range of uses, such as in pipe lines for pneumatic tampers, has been placed on the market by the Hoosier Iron Works, Kokomo, Ind. This coupling, which uses either rubber or composition gaskets, is applicable to plain or threaded pipes in lines conveying gases or liquids at high or low internal pressures. It consists of three metal parts, a half-cylinder cradle with two slotted arms, a half cylinder cap and a cam clamp which engages the slots in the arms of the cradle and exerts pressure to force the upper cap or housing against the lower half-cylinder.

The cam clamp is operated by a removable lever that fits into a socket in the head of the cam, which is so shaped as to fold in between the rounded arms of the cradle or lower housing so that when the operating lever is removed no projection remains which might cause the clamp to be loosened. This feature is especially advantageous in operations requiring the transfer of hose over the pipe line and couplings.

The gaskets for the new coupling are designated to dovetail into grooves in the upper and lower housings; therefore, no rivets are necessary to hold the gaskets in place. It is claimed that with rubber gaskets, flexibility in the alinement of connected pipes or tubes up to 40 deg. at a joint may be obtained with this coupling. Such gaskets also allow longitudinal expansion of from 3/8 in. to 1/2 in. per joint. It is said that this coupling will withstand internal pressures greater than 150 lb. per sq. in.

Showing the Various Parts of the Threadless Flexible Coupling

In railroad service, this coupling may be used on air lines to portable pneumatic tie tampers or other compressed-air tools, as a quick-opening joint in water lines during freezing weather where periodical drainage is necessary, as a flexible joint where permanent lines traverse unstable ground, or as a patch that can be applied quickly over a leak in a pipe line.

Develops Bolt Tightener of New Design

A NEW power bolt tightener, known as the Raco Nutter, which has as an important feature two chucks operating at high and low speeds respectively, has been placed on the market by the Railroad Accessories Corporation, New York. Essentially, the unit consists of a split-wheel-supported chassis carrying the engine and power transmission over one rail, with the operating head and chucks on the end of a horizontal arm, the design being such that the operating head may be swung around in a horizontal plane to permit bolts on

The Operating Head of the Raco Nutter may be Swung Through a Horizontal Plane to Permit Any Bolt to Be Reached by Either Chuck.

either side of the rail to be reached by either of the chucks. An insulated supporting roller on the end of an outboard arm reaches to the opposite rail, while the weight of the operating head is counterbalanced by a readily removable weight at the rear of the machine.

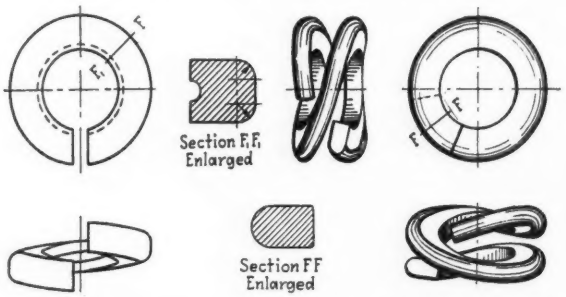
The machine is powered with a single-cylinder 4-hp. 4-cycle air-cooled engine. Power is transmitted from the engine to a reduction gear that operates the nutting head through a disc clutch of large area, which consists of a steel disc which slides on a spline on the engine shaft and a fiber-faced spider mounted on the end of the worm gear in the reduction gear housing. Two fingers pressing against the steel disc are integral with a dynamometer arm carrying a sliding weight, the amount of friction between the two discs, which is a measure of the torque developed, being controlled by the position of the weight on the dynamometer arm. By means of this device, it is said that any bolt tension between 1,000 and 42,000 lb. per sq. in. may be obtained.

Both of the chucks, which are of the self-centering type, revolve when the power connection is made. The high-speed chuck operates at 80 r.p.m. at normal engine speed and the low speed chuck at 20 r.p.m., the latter exerting a torque of 10,500 in.-lb. Operation of the chucks is controlled by a clutch lever and a small reverse lever located on the operating head directly under the two handles by means of which the horizontal movement of the operating head is controlled.

The working parts of this machine are made of heat-treated chrome-vanadium and chrome-molybdenum steel, while the castings are of semi-steel or aluminum. All tubular parts of alloy steel tubing. The machine weighs 350 lb. and is operated by one man.

New Spring Washers

TWO new types of spring washers, designated as the Double Hipower spring washer and the National Grooved spring washer, have been developed by the National Lock Washer Company, Newark, N. J. The Double Hipower Washer is similar to the Improved Hipower washer of this company, with the exception that it has a double coil while the Improved Hipower has a



Drawings of the Grooved Spring Washer (Left) and the Double Hipower (Right)

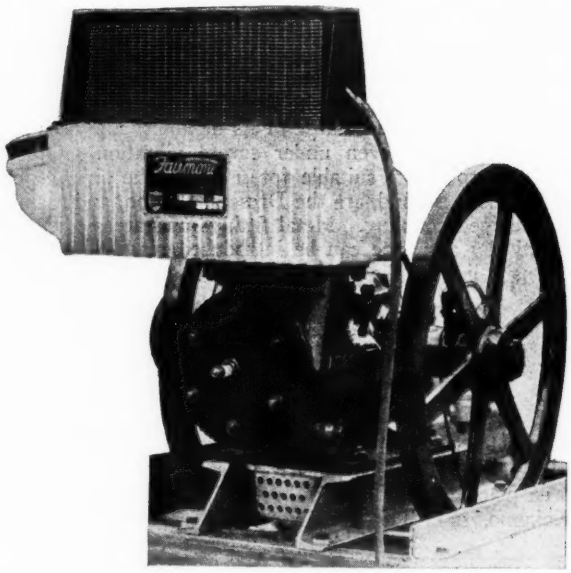
single coil. The new washer is said to develop a compression at solid height equal to any load to which it may be subjected by wrench or traffic under normal maintenance conditions.

The grooved spring washer derives its name from the fact that a groove is rolled in the inner periphery of each washer. This groove was inserted as a means of reducing to a minimum the internal stresses that are set up in the metal on the inside of the washers during the coiling process. The groove is said to permit the metal to move easily in adjusting itself to the distortion. A further advantage claimed for the groove is that it exposes a greater surface area to the flame, thereby providing a balanced section for heat-treating purposes.

Another unusual feature of the grooved washer is the double chamfer that is provided at the corners of the outer periphery, in place of a semi-circular arc. This is said to present a maximum bearing area against the nut and joint bar. In addition, the end edges are bevelled, which feature is said to eliminate mutilation of the nut and possible damage to the spring washer if it becomes necessary to back up the nut.

Light Weight Engine for Fairmont Motor Cars

IMPROVEMENTS in design and construction are embodied in a new light-weight engine, designated as Type O, which is now being furnished in the M14 light section car and the M9, 59 and M19 inspection cars built by Fairmont Railway Motors, Inc., Fairmont, Minn. The



The New Fairmont O Engine

new engine develops from 5 to 8 hp., as compared with 4 to 6 hp. for old engines having the same bore and stroke. The increase in power has been made possible by developing higher compression, provision having been made also for the requisite increase in cooling capacity.

Vibration of the cars is reduced by lighter reciprocating parts in the new engine, the piston and connecting rod being made of an aluminum alloy. The crankshaft runs on three ball bearings and is equipped with Ringseald "piston ring" packing. Ready access to the ports in the engine for carbon removal is afforded by the outside position of the cylinder head.

The water jacket in the new engine extends back of the ports, thus cooling the piston and rings on their full stroke. The cooling hopper is of cast aluminum, designed to afford a large area for evaporation and with fins cast on the front to increase the cooling capacity. The filler cap is located at the water level in order to avoid over-filling and to prevent damage by freezing. A steam condenser located above the water hopper is said to recapture practically all water that is evaporated, so that only one filling a week is sufficient for some inspection cars that are in use every day. It is said that no

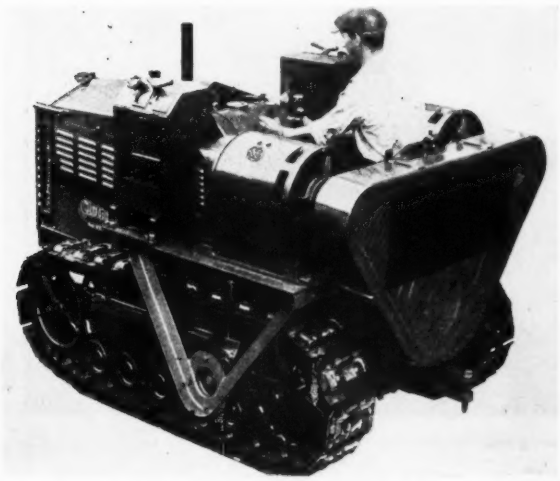
steam or hot water from the engine can fall on the occupants of the car, as the only outlet is a pressure hose beneath the car.

The new engine is equipped with an aluminum carburetor with a combined choke and needle-valve control on the seat top.

General Electric Arc-Welding Sets in Two Mountings

ELECTRIC welding units applicable to the building up of battered rail ends and the repairing of bridges, worn frogs and switches, which are manufactured by the General Electric Company, Schenectady, N. Y., have now been made available in two types of portable mountings. One of these mountings is a four-wheel rail car, equipped with transverse wheels for facilitating the removal of the equipment from the rails. The jacks on which these wheels are mounted are operated by a crank located on one side of the chassis. This unit is also provided with a lifting bail which permits the set to be handled by a crane. One of the accompanying illustrations shows one of four such units embodying General Electric 300-amp., engine-driven, arc-welding sets, which were recently delivered to a large eastern railroad.

A Rail-Car-Mounted General Electric 300-Amp. Arc-Welding Set



Two General Electric Arc-Welding Sets Mounted on a Crawler Tractor

The other type of mounting consists of a crawler-type tractor upon which either one or two single-operator arc-welding generators with their control are mounted. Such a unit, embodying a Cletrac tractor equipped with two 200-amp., 40-volt arc-welding generator sets, is shown in one of the illustrations.

New Pipe Coupling Developed

A NEW type of pipe coupling, known as the Champion Positive Seal Pipe Coupling, which is applicable to the joining of straight plain-end pipe without grooving, threading, beveling or upsetting the ends, has been developed by the Champion Machine & Forging Company, Cleveland, Ohio. This coupling consists of two half-cylinder coupling sections containing gripping rings, a gasket with metal protected sections, and two bolts. The coupling sections are of drop-forged steel, while the gripping rings are drop-forged and heat treated and are said to be so assembled into the coupling sections as to become integral with them.

The Champion Positive Seal Pipe Coupling

The gasket is said to be so designed as to provide a double seal that is equally effective against either pressure or vacuum. It is claimed that these couplings have been tested under pressures up to 4,000 lb. per sq. in. They can be applied by unskilled labor and may be broken down and made up again any number of times without, it is claimed, impairing their efficiency.

Improved Nordberg Power Track Wrench

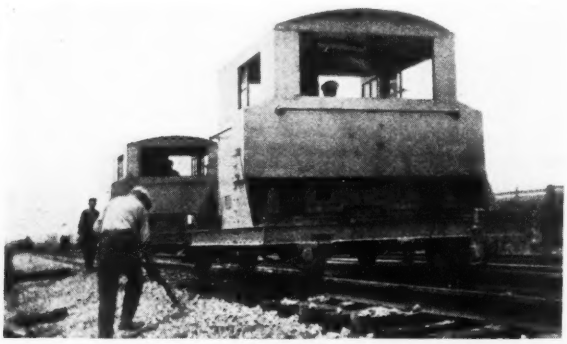
EXTENDED experience with the power track wrench of the Nordberg Manufacturing Company, Milwaukee, Wis., which was placed on the market somewhat

The Improved Nordberg Power Track Wrench

more than a year ago, has led to a number of improvements in design. One of these is a new type of mechanical frictionless overload release device which is said to be simple in design and to maintain unusual uniformity in bolt tension. Another improvement is embodied in new types of controls, which permit greater convenience and ease of operation of this equipment. When the Nordberg power track wrench, described in *Railway Engineering and Maintenance* for March, 1933, was first developed, it was thought that it would be used principally in loosening and tightening bolts in rail-laying operations, but experience has shown that its greatest application is in the out-of-face tightening of bolts to maintain the proper tension.

Power Track Ballaster Adapted to Crib Cleaning

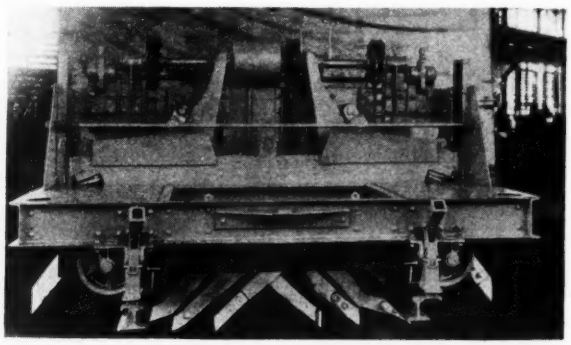
THE mechanical cleaning of tie cribs in one half minute to one minute, depending on the extent to which the ballast is compacted, is now being accomplished by a machine that comprises an adaptation of the Jackson power ballaster which is being marketed by the Power Ballaster Company, Chicago. The power ballaster consists essentially of a series of heavy hinged tamping shoes attached to the lower part of a heavy crosshead extending across the track for the full length of the ties and mounted on a four-wheel car which carries the power plant and operating mechanism. The crosshead operates freely in guides and falls a distance of 2½ ft. When adapted to the cleaning of cribs, the machine is the same in every particular except that the crib-cleaning crosshead is inserted in place of that carrying the tamping shoes.



The Jackson Power Ballaster

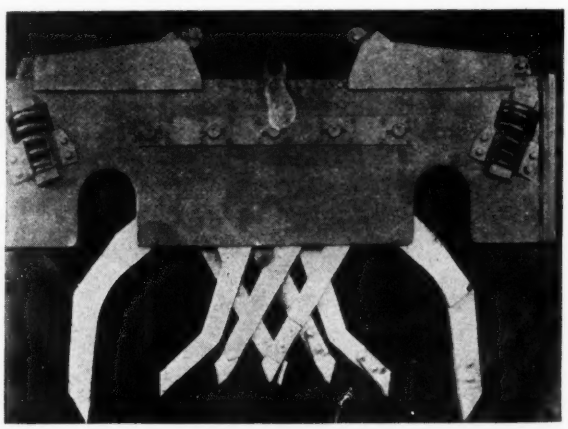
The crib-cleaning crosshead, which weighs 3,800 lb., is provided with eight heavy bars, each of which is equipped with a renewable shoe five inches wide. The bars are suspended from the crosshead by means of pins so that they swing in a transverse vertical plane, four having a motion toward one side and the other four to the opposite side. Of the bars in each set, three operate between the rails and one outside. The inside bar of each set has an extension above the pivot pin, with a roller at its upper end that engages the surface of a heavy vertical guide supported on the body of the car, but designed to bear on the rail, the contour of this guide being such that as the crosshead descends, the lower end of the bar is given a constantly increasing lateral motion away from the center line of the track. In addition cams are provided on the sides of the bars where they come in contact with each other, of such shape that each succeeding bar from the center to the outside is given an increasing lateral motion. The result of this arrangement of the bars is to cause them to dig into the ballast as the crosshead starts its downward motion and then exert an increasing force to push it out to the side as the stroke is completed. The greater lateral motion of the outer bars increases the movement of the ballast as it approaches the side, the bar outside the rail giving it a forcible kick over the shoulder. With this machine, the cribs may be cleaned to a depth of from one to five inches below the bottom of the ties.

The crosshead is raised by means of dogs on the links of two endless chains and is released as the dog links pass over the top sprockets, whereupon it drops freely in its guides. During the initial stroke, while the crib is still partly filled, the bars deliver the full force of the blow to the ballast, but to meet the condition encountered when the crib is nearly empty and the bars attain their extreme lateral position, a rubber cushioned shoe is introduced over each rail to bring the crosshead to rest, the impact being dissipated by shock absorbers in the crosshead.



In This View the Crosshead Is at the Bottom of the Stroke

The cribbing machine is said to be equally effective in any type of ballast. It delivers 34 blows a minute and its use for cleaning the cribs on 18 miles of track on an eastern railroad demonstrated that the average length of time required to clean a crib was about 30 sec. Where the ballast is compacted tightly or is frozen, it is said that not more than 45 to 50 sec. is required to clean each crib.



Showing the Relationship of the Digger Bars With the Crosshead in the Raised Position

The machine, which is operated by one man, is powered with a 52-hp. 6-cylinder Hercules engine and is self-propelled, both for spotting over the cribs and for traveling.

What's the Answer?

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions that you may wish to have discussed.

Independently Fastened Tie Plates

What are the advantages and disadvantages of fastening tie plates to the ties independently of the rail? How does this form of construction affect track maintenance?

Practice Is of Great Advantage

By ROY W. PUTNAM

Roadmaster, Southern Pacific, Oakridge, Ore.

I consider this form of construction of great advantage, since it will reduce the wear of the ties, and in large measure the life of treated ties is determined by the extent of the mechanical destruction to which they are subjected. In other words, most of them wear out before they decay. Tie plates which depend on the same fastening as the rail move up and down with the rail. This action abrades the wood fibres and affords an opportunity for the entrance of water, which, in turn, softens the wood under the tie plates and thus accelerates the rate at which abrasion progresses.

If a tie plate is fastened securely to the tie so that it is not free to move, it will do away almost entirely with this form of destructive wear under the rail, the wear being transferred to the bearing between the rail and the plate. This will reduce the labor involved in gaging, lining and surfacing. The reason for this is that a small deviation in gage is always the starting point for a deviation in line and this latter defect, in turn, causes irregular surface. The exact method of fastening the plates to the ties, to eliminate the relative movement between the two is not under discussion, but it is in order to say that, however it is accomplished, the cost will be more than offset by the saving in maintenance.

Favors This Method of Fastening Tie Plates

By W. RAMBO

Roadmaster, Missouri Pacific, Poplar Bluff, Mo.

From experience with this type of construction I am decidedly in favor of fastening the tie plates to the ties independently of the fastening for the rail. This is said, however, with the proviso that the method of fastening shall be such as to hold the tie plate in place at all times and prevent any relative movement between the plate and the tie. If elimination of this movement is not assured, and the tie plate is not kept rigidly attached to the tie, any attempt to provide an independent form of fastening for the plate is merely a waste of time and effort. Further than this, it will create unnecessary expense in maintenance, for the reason that it will soon become necessary to regage the track, in which event the independent fastenings must be removed and replaced.

It has been proved by ample experience under a wide variety of conditions, that the tie plate can be fastened securely to the tie, entirely independent of the fastenings for the rail. Where this is done, it is found that regaging of the track is eliminated, better alinement is maintained with less effort, and much of the noise created by passing trains is eliminated.

My idea of the proper fastening is that two lag screws should be used to each tie plate, one at each end, staggered, that is, placed approximately on one of the diagonals of the plate. These screws should be 5/8 in. by 6¾ in., and should be seated firmly to insure a rigid bearing between the tie and the plate. If this or some other equally effective fastening is used, the advantages that have been mentioned will be quickly demonstrated. So far as I know there are no disadvantages.

Independent Fastenings Reduce Wear on Ties

By Supervisor of Track

This method of attaching the tie plates to the ties has numerous advantages, which far outweigh the few disadvantages, which are of small importance. When the tie plate is held rigidly to the tie, the destruction of the wood fibres under the plate by reason of abrasion is substantially eliminated, thus increasing the life of the ties. The rigidly-held tie plate permits the shoulder to take the lateral thrust of the rail by utilizing the friction between the wood and the plate as well as the additional resistance offered by the independent fastenings. This relieves the spikes that hold the rail of some of their load and reduces the tendency of these spikes to push through the wood. As a result, the necessity for frequent gaging is nearly or entirely eliminated. This method of fastening the tie plates makes quieter track, since the wave motion in the rail does not raise the tie plates and cause them to clatter.

To Be Answered in May

1. *Should a definite period be allotted for making tie renewals, or should they be made, as convenient, throughout the entire working season? Why?*
2. *What precautions should be taken to prevent leakage around drainage openings through waterproofed surfaces?*
3. *Should track be gaged before or after it is lined? Why?*
4. *What is the most practicable method of providing staging for painters engaged in painting wooden tanks? Steel tanks? What precautions should be observed?*
5. *What precautions should be observed in applying and maintaining insulated joints? Why?*
6. *Where concrete in a locomotive coaling plant or other structure having thin sections is damaged or deteriorates so that the reinforcement is exposed, how can repairs be made?*
7. *Where tie plates have fastenings independent of the rail, what form of fastening should be used for the tie plate? What form for the rail? Why?*
8. *How frequently should wire rope used in hoisting equipment be inspected? What are the indications that determine when replacement shall be made?*

This construction reduces maintenance by increasing the life of the tie, by the lessened effort that is necessary to maintain line, gage and surface and by the less frequent tie renewals that are necessary. The work involved in removing the plates in connection with tie or rail renewals or when the plates themselves are replaced, is increased over that necessary where the ordinary method of fastening is employed, but the additional time involved is so small that it is hardly worth mentioning when the advantages are considered.

[Additional answers were received from Louis M. Rodrek, section foreman, M. St. P. & S. Ste. M.; from W. H. Sparks, general inspector of track, C. & O.; and E. E. Edwards, Southern Pacific. Mr. Rodrek, while recognizing some of the advantages that have been mentioned in the foregoing discussions, considered that these are outweighed by the difficulties encountered in gaging track and renewing ties. Although his experience with this construction is relatively short, Mr. Sparks expressed the belief that the improvement in gage alone will outweigh any minor disadvantages that may develop. Mr. Edwards has used this construction only on curves, "and here," he said, "it is of decided advantage in holding gage and reducing the damage to ties."—Editor]

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Loose Rivets

What are the evidences of loose rivets? What does their presence indicate with reference to the condition of the structure?

Generally Indicate Poor Design

By JOHN L. VOGEL
Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

In designing riveted connections, a thorough understanding is needed of the conditions and of the various actions to which rivets are subjected, in order to provide an efficient joint. Furthermore, the actual fabrication and construction should be subject to very careful inspection. If these requirements are met honestly, the chance of loose rivets developing is very remote.

Loose rivets in railway bridges are generally found in connections consisting of two rivets. Good practice, however, requires that less than three rivets shall never be used. Not many years ago, it was common practice to connect lateral angles to struts or floor members, in order to prevent sag in the laterals, by merely riveting the lateral with one or two rivets to the connecting member. Owing to the deflections of the connecting members, and also to indeterminate strains that are set up in the lateral by reason of these connections, a movement is created, which tends to loosen the rivet or rivets in the connection. Furthermore, if there is a slight movement of the rivet, the way is opened for the entrance of dampness or perhaps of water, which tends to accelerate the further loosening of the rivet, and only by the closest attention and best practice of maintenance can this be prevented. This condition exists in a number of the older structures, and when repairs are made to such a connection, it is necessary to modify the details of the fastening. If the loose rivet is merely removed and replaced with a new one, the condition will soon revert to its original status and will again require the same attention. This condition represents the only real trouble we have had with loose rivets.

On the other hand, there have been a few cases where loose rivets have been detected in connections between short-span approach girders and the longer-span main girders. This condition can be attributed mainly to improper design, in which continuity or excessive deflection of the main span has been ignored. Such a condition might also be caused by a slight settlement of the approach girder where it rests on a masonry bearing. As a rule, this condition is not dangerous, provided the short-span girder has a further bearing at the connection on either a bracket or a column. In general, a proper analysis of the connection will point the way to the remedy. Again, a simple way of overcoming the trouble may be to ream the holes and apply turned bolts.

May Be Evidence of Overloading

By H. M. BAKER
Assistant Bridge and Building Supervisor, Missouri Pacific, Monroe, La.

Rivets are sometimes loose because they are too small or because the head is formed before they have been upset enough to fill the hole. Such rivets can be detected easily at the time of driving by tapping them lightly with a hammer. A rivet that has been loose for any time indicates its presence by a ring or streak of rust. Wherever rivets or connections have rust streaks, an immediate examination should be made, since this is evidence that movement is occurring. Here again the loose rivets can be found by tapping them lightly with a hammer.

In general, the presence of loose rivets is a certain indication that the structure or some of its parts is in poor condition. This may be the result of improperly designed connections, poor maintenance or, as is often the case, of overloading either the structure as a whole or some of its parts. In many cases the floor system is the weakest part of a steel span, and where this part of the structure is overloaded, loose rivets are likely to develop in the stringer connections and in the end connections of the floor beams. Immediate steps should be taken to correct the trouble, since if it is ignored, it will spread and may soon involve the whole structure.

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Sliding Embankments

When slides endanger the track on embankments, how should temporary repairs be made? How do locomotive cinders compare with other materials for restoring the embankment?

Temporary Repairs Must Be Safe

By H. T. LIVINGSTON
Division Engineer, Chicago, Rock Island & Pacific, Little Rock, Ark.

Many elements must be known before this question can be answered intelligently, since it is common knowledge that all slides do not originate from the same cause. Among the causes most frequently encountered are faulty interior drainage of embankments; non-uniform subsidence of the supporting ground; steep slopes (cleavage planes) in hard, slippery or slaty ground; non-homogeneous material in the embankment; exterior wash along the toe of the slope, which removes the support from the upper material of the embankment; heavy filling superimposed on light material; and others too numerous to mention.

Temporary repairs must serve to carry traffic over the affected places safely until permanent repairs can be made. If the slide occurs on double-track embankments, it may be desirable to resort temporarily to single-track operation. On single track, if the embankment is of suf-

ficient width and known to be stable except for the slide, the track can often be lined over and made passable.

In general, the practice of filling the slide with any material that may be available is a slow process, since the supporting base usually moves under the new and additional load. In such cases, I have generally resorted to the driving of piling. In doing this, the piles are placed about 10 ft. from the center and on each side of the track. Opposing piles are then connected with steel rods not less than 1¼ in. in diameter, car-truss rods generally being used, since they are usually readily available. The piles are usually spaced along the track on four to seven-foot centers, depending on the supporting power of the embankment material. After this work has been completed through the limits of the slide, a suitable filling material is unloaded between the piling and the track is brought to line and surface. This type of repairs should last until the piles decay, provided the points have penetrated well below the moving material. I have used locomotive cinders for restoring the embankment in such emergencies, but prefer a less porous material. Cinders remain to form water pockets, which aggravate the condition that must be overcome.

It is imperative that the officer directly responsible for the safety of trains shall know that the repairs that are made are capable of supporting the loads that must pass over the slide. For this reason, it is hardly possible to make a definite and categorical answer to the question that will guarantee the same results in all cases.

Remedy Depends Largely on Cause

By Engineer Maintenance of Way

While there appear to be many underlying causes for sliding embankments, some of which seem to differ widely from the others, it has been my experience that in the great majority of cases the trouble can be traced to some form of defective drainage. This may have its seat in the embankment itself or in the supporting soil. If in the latter, the slide may be merely an incident to subsidence; or on steep hillsides the soil may absorb water and move laterally on sloping rock and by carrying the embankment with it, induce secondary slides from the shoulder of the roadbed. If the defective drainage is in the interior of the embankment, the shoulders usually become saturated and slough, sometimes well within the ballast section or even inside the ties or rail. Slides of this character often occur with little or no previous warning.

Slides of any considerable magnitude are almost certain to affect the safety of the track and, therefore, require prompt action. Obviously, the remedy depends on the cause. Where the trouble lies in the embankment itself, as is the usual situation, several courses are open. On multiple-track lines it is usually possible to abandon the affected track until it can be made safe by other than emergency action; on single track it may be possible to line the track around the slide, even if necessary to cut the roadbed down as much as two or three feet to make this practicable. Where these expedients are not possible, other means must be devised.

Where the slide did not result from saturation of the embankment, I have found locomotive cinders to give satisfaction in restoring the roadbed. If caused by water in the material composing the embankment, the use of any filling material alone is usually inexpedient. In such cases, it has been my experience that the best method is to drive a row of piling on each side of the track parallel to and about 10 ft. from the center line, the spacing and penetration being those best suited to the conditions at each point affected. Opposing piling are tied together with rods extending across and under the track. If necessary, boards can be nailed on the piling to retain the temporary fill. Filling, such as cinders, granulated slag or other light material, can then be unloaded and the track restored to line and surface. If the slide results from erosion by high water, it may be necessary to unload heavy riprap to provide a support for the temporary filling. Whatever the cause of the slide, permanent repairs should include the removal of this cause.

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Gage Plates or Gage Rods

Are gage plates, or gage rods immediately ahead of the switch points, preferable for main-line switches? For yard switches? Why? Does it make any difference whether the turnout is on tangent or curve?

Few Conditions Require Their Use

By J. A. PEABODY

Engineer of Maintenance, Chicago & North Western, Chicago

There are a few places on the open road where the ordinary switch plate and rail brace are not sufficient ahead of the main track switch points. An interlocked switch, where the working of the machinery requires an exact fit, is one location for a gage plate. Switches where the movements through the turnout are so frequent as to tend to spread the gage in advance of the switch points sometimes can be benefited by the insertion of a gage plate. As a general rule, however, I do not favor a gage plate in the main track, except at interlockings, because at the tie upon which there is a gage plate we introduce a rigidity of gage greater than at other places in the track in the immediate vicinity.

On busy switching ladders where there are heavy movements through turnouts, I am very much in favor of the gage plate in advance of the switch points. Such locations require considerable regaging, with consequent destruction of the ties, which the gage plate will largely overcome. In side-track turnouts, the sudden rigidity of gage, which is generally slightly widened is not objectionable.

In other words, I believe in using the gage plate in advance of switch points only at such locations, outside of interlockings, as rigidity of gage caused by the use of such plate, is less objectionable than an irregularity of gage which cannot be prevented otherwise than by constant respiking.

Has Increased Use of Gage Rods

By H. R. CLARKE

Engineer Maintenance of Way, Chicago, Burlington & Quincy, Chicago

Where gage plates, with braces of such design that gage was properly maintained, were used on the first head block immediately under the switch points, we found it entirely possible until comparatively recently to maintain switches very satisfactorily without using either gage plates or gage rods immediately ahead of the switch points. As wheel loads, particularly on locomotives, have become heavier, and as the rigid wheel base of locomotives has become longer, we have found it increasingly difficult to maintain accurate gage at the switch points. Even with the first or No. 1 plate continuous, and with braces applied so that gage was definitely established, wide gage developed as a result of wear of all of the parts, and immediately ahead of the points where the

thrust is greatest as the wheels leave the turnout curve and take the tangent, the difficulty was even greater. To overcome this difficulty, we are finding it desirable to use gage rods applied a short distance ahead of the points. Usually one rod is sufficient.

For some time, gage rods have been used in this way where the switch lead was short with consequent sharp turnout curvature or where the turnout was so located on a curve as to increase the thrust at and immediately ahead of the points. We found the gage rod a material help when used in this way and, as already indicated, we are now finding it desirable to use this device more generally.

Gage rods are perhaps more necessary on main-line switches in automatic signaled territory than on yard switches or in territory where there are no automatic signals, for the reason that the switch boxes controlling the signals are so adjusted that a comparatively slight widening of the gage sets the signals, thus making necessary frequent adjustment of the switch box mechanism. Since short leads with consequent sharp curvature are more general in yards than in main line turnouts, gage rods were used more frequently on yard switches than on the main line until comparatively recently.

It is possible under average conditions to maintain gage without gage rods, so that the track structure is entirely safe. Owing to the tendency of the gage to widen, as mentioned, it is necessary, however, to adjust the throw of the switches from time to time to compensate for the increasing gage width, and in automatic-signal territory this is even more objectionable.

Prefers Gage Plates to Gage Rods

By LOUIS M. RODREK
Section Foreman, Minneapolis, St. Paul & Sault Ste. Marie, Neenah, Wis.

I prefer gage plates to gage rods ahead of the switch points, because the former are fastened to the ties and remain in position. Gage rods are merely hooked over the flanges of the rails and for this reason tend to slide back and forth, apparently as a result of vibration from trains, and as the rods become skewed, they tend to tighten the gage. It is desirable to have gage plates both under and ahead of all switch points, but this is not as necessary on tangents as on curves, except where there is a reasonably heavy traffic through the turnout. Where ties have become worn, the plates add appreciably to the support of the track, while rods are of no help, so far as bearing is concerned, where ties are weakening. In cases of derailment, and many of these occur at switches, the gage plates protect the ties from damage, where rods not only are of no benefit but may themselves sustain irreparable damage.

Sometimes Used Where Not Justified

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

To begin with, I am a firm believer in both gage rods and gage plates, but recognize that, like all other devices, they should be used with judgment. I have seen, in both main-line and branch-line switches, where they represented sheer waste, because the particular conditions did not justify their use. Turnouts constructed according to A.R.E.A. standards have heavy plates and rail braces to resist the tendency toward wider gage. Where there is only a moderate traffic through the turnout, there is scarcely any greater tendency at the points than elsewhere, particularly on tangent, for the track to get out of gage.

On sharp curves the gage often tends to widen at and just ahead of the points. In such cases, either gage rods or gage plates, according to local conditions, will do much to stiffen the track. If there is considerable traffic through the turnout, added resistance must be provided against the tendency toward wider gage. This becomes more necessary as the lead is shortened, as the speed or volume of traffic through the turnout increases and, if the turnout is on a curve, as the curvature increases. Gage plates and rods are a real advantage when applied ahead of busy yard switches, the particular device again being determined by the factors already mentioned. Locomotives and cars are constantly growing heavier, and wheel bases longer, leads are generally shorter than on the main line, while much of the switch material is second hand, so that the tendency to widen the gage at the point is correspondingly increased.

Gage Plates Demonstrate Greater Efficiency

By Supervisor of Track

From the standpoint of efficiency, gage plates are to be preferred to gage rods, when applied to either main-line or yard turnout. If gage plates are not available, gage rods are acceptable as a substitute, since they are far better than no protection. Among the advantages of gage plates as compared with gage rods, the adjustable rail brace provided with the former insures that the stock rail will remain vertical, since it offers much greater resistance to overturning than the gage rod. This is important because the stock rail is not spiked on the inside throughout the length of the switch point. Gage plates keep the track in better alinement, since they cannot move on the ties. Gage rods hold the gage but do not prevent the rail from moving on the ties. This is particularly true with respect to the tie to which the switch stand is attached, for switches are found occasionally where the tie moves under the stock rail, owing to the pull or thrust of the connecting rod when the switch is thrown. This condition is not conducive to good switch adjustment.

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Crib Retaining Walls

Under what conditions are crib walls of metal or concrete units preferable to solid masonry walls? What are their limitations? What precautions are necessary in their construction?

Should Be Filled with Pervious Material

By L. W. SKOV
Designing Engineer, Chicago, Burlington & Quincy, Chicago

Concrete or metal crib walls can be used to advantage where sufficient batter can be obtained for the front face and where the loading and the height of the wall are not excessive. They are particularly economical where only a small section of wall is required, where storage space for construction materials is limited or where mixing water is not readily available. Care should be taken in placing the units, since localized bearing stresses as a result of being out of true may be sufficient to cause spalling in concrete units.

Crib walls 10 ft. or more in height should be supported on concrete footings, placed under the stretchers, particularly where subject to railway or other heavy loading. They should be not less than 18 in. wide, 12 in. thick and have at least four ¾-in. reinforcing bars. The filling

material should be pervious, this being especially important for walls having a northern exposure in cold climates. The fill should progress with the wall and should be well-tamped under all headers. If this is not done, much damage in the form of distorted or broken headers will ensue. Even low walls may have nearly all of the headers broken in a short time unless proper care is exercised in placing the fill.

Not Safe to Use on Unstable Foundations

By M. F. CLEMENTS

Bridge Engineer, Northern Pacific, St. Paul, Minn.

I have had no experience with metal units, but have used concrete crib walls in a number of instances. In general, concrete crib walls may be used with economy, as compared with solid masonry walls, where the foundation material is reasonably solid. Slight settlement does not cause injury to walls of the crib type. We have had experience with concrete crib walls, however, in sloping debris from rock cliffs, where water came in contact with the foundations. Under these circumstances, settlement was greater than the sections were able to resist and the walls failed.

This Question Requires Careful Analysis

By JOHN L. VOGEL

Bridge Engineer, Delaware, Lackawanna & Western, Hoboken, N. J.

This question involves numerous factors, all of which must be analyzed carefully before making a decision as to the advisability of using the crib type of wall. Assuming that the crib is a practical and economical solution of the problem, however, the question immediately arises as to whether concrete and metal units are equally adapted for the proposed construction, and if not, which is to be preferred. This also requires careful study and investigation.

Metal units for crib-wall construction can be designed correctly as to section but their service life is an unknown quantity, since metal cribbing is a relatively new product, which has been in use an insufficient time to enable its performance to be compared with that of concrete cribbing, particularly in railway work where conditions are most severe. On the other hand, the claims made by the manufacturer as to probable life are based on dependable records of long service life of the metal of which they are made, in other applications where many equally severe corrosive conditions are encountered. There is no doubt as to the strength of the units, or of the wall where it is properly designed, the flexibility or the cheapness of metal units.

Concrete crib walls have been in use for many years and in general have given satisfaction, where careful supervision has been exercised in their design and in the fabrication of the units, including section, reinforcing and curing, as well as of the materials of which they are made. To be satisfactory, the concrete must be of the highest quality, preferably vibrated. Reinforcing should be held accurately in place and at a depth to assure ample cover protection. Both metal and concrete units should be of such design as to assure flexibility in the crib, which will permit it to move freely in any direction up to a reasonable limit without failure.

Whether crib walls are preferable to solid masonry involves both economy and appearance. Experience demonstrates that crib-wall construction is best suited to those situations where foundation conditions are difficult, where future developments may require removal of the wall or where time is a vital factor of construction. Again, the correct solution to wing and retaining-wall extension problems has often been found in crib construction. From actual experience I have found that crib walls constructed of properly designed units will stand excessive settlement and lateral movement without injury to the wall as a whole or to the individual units. We have built such walls 20 ft. high on compressible foundations, which have resisted the severest strains and yet have retained both their elevation and alinement.

Summing up briefly, the advantage of crib retaining walls is that they can be constructed in restricted areas; they can be erected on soils that would otherwise require piles; the minimum amount of equipment is required in their construction; foundation excavation is small; they can be built in short sections, thereby eliminating expensive shoring or falsework; they can be erected quickly; filling can progress at the same rate as the wall is built up; alterations can be made easily at any time, as needed; climatic conditions place no restrictions on erection; and full salvage can be obtained.

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Storing Fuel Oil

What is the best method of storing fuel oil at water stations where internal-combustion engines are used?

Underground Storage Is Preferable

By J. H. DAVIDSON

Water Engineer, Missouri-Kansas-Texas, Parsons, Kan.

Most of the states have regulations governing the storage and use of inflammable materials. Since those relating to fuel oils vary with the quantity stored, the location of the storage with reference to adjoining property, its proximity to railways carrying passenger traffic and the topography, all of these factors must be considered when providing storage for fuel oil that is to be used in internal combustion engines. Two other important factors that must be taken into account are the climatic conditions and the methods available for transporting and unloading the oil at the water stations.

If the station uses comparatively small quantities of gasoline, distillate or other similar light fuels, it may be economical to store the fuel in original sealed containers approved by the Interstate Commerce Commission, since they meet all of the requirements governing the storage of such fuels. If, on the other hand, the quantity or quality of the oil is such that the use of these containers is not economical, a suitable storage tank should be provided.

Under certain conditions, it is advantageous to place the storage tank above ground on a suitable foundation to provide for gravity flow of the oil to the auxiliary tank that is used for supplying the engines. In cold climates, however, such storage of the heavier grades of oil will require facilities for heating to insure that they will flow during cold weather, thus increasing the cost of both construction and operation.

Storage in underground tanks eliminates many of the hazards incident to above-ground storage. For this reason it is permitted by state authorities under conditions that would prohibit above-ground storage. In mild climates, heavy grades of oil can be drawn from underground storage without the application of heat. Furthermore, in the event that some heat is necessary, it will be much less than that required for above-ground storage in the same locality. During hot weather the evaporation losses from underground storage are held to the minimum, while above-ground they are considerable.

For these reasons, underground storage is preferable in most cases at water stations where internal-combustion engines are used. Before constructing storage facilities of any type, however, state regulations governing this matter should be studied carefully. They will be found to contain valuable information concerning location, materials and methods.

Should Eliminate Fire Hazard

By ANDREW FINNES

Master Carpenter, Great Northern, Minot, N. D.

Fuel oil can be stored in steel tanks which are placed in concrete or brick vaults. They should be located not less than 50 ft. from the pump house, or enough farther away to eliminate fire hazard. At small stations where a limited quantity of oil is consumed, a single tank may be utilized for storage as well as for supplying the engine; at more important stations there should be separate storage and supply tanks. The top of the supply tank should be placed below the level of the engine, so that any excess oil can readily flow back through the return line and not flood the engine. Care should be exercised, however, because if the supply tank is placed too low, the suction lift may become too great for the engine fuel pump and engine trouble may then ensue, particularly when the tank is nearly empty.

Storage tanks of either type should be of sufficient capacity to hold the amount consumed between supply-car dates, with sufficient margin to insure against possible delays in making delivery. At stations of large consumption, the storage should be well away from the pump house, with a gravity pipe line to the supply tank in the vault. Where the pump house is near a track, the storage tank should be located so that it will be within the reach of the supply-car hose for filling. Where the distance must be too great to permit the use of the hose, a pipe line, with unloading connections at the track, should extend to this tank. In situations where the distance and elevation will not permit the use of the pipe line, the supply must be obtained either in barrels or from truck delivery.

Local Conditions Determine Largely

By A. B. PIERCE

Engineer Water Supply

To a large extent, the best method or layout to be used for storing fuel oil at water stations is determined by local conditions. Where practicable, storage tanks should be installed adjacent to sidings to allow the tank car to be unloaded without interfering with or delaying train movements. The storage tank should be placed several feet below the elevation of the siding to permit the oil to flow by gravity from the car to the tank.

At the more important stations, oil-storage tanks should have capacities of 12,000 or 14,000 gal. to permit the purchase of a full tank car of 10,000 gal. Where there are several less important stations on a division, smaller tanks of, say, 3,000 to 5,000-gal. capacity, can be installed and a full tank car of oil purchased to supply two or more stations.

Oil-storage tanks may be erected on three or four concrete saddles, which will expose them for inspection, painting, the detection of leaks, and maintenance. Where necessary, to provide a gravity flow in taking delivery from cars, they may be installed in concrete pits. In either event, however, auxiliary tanks should be provided for the service supply at the pump house, placed at such an elevation that they can be supplied by gravity from the storage by means of a connecting pipe line. Auxiliary tanks should hold at least one week's supply of oil. They are usually placed in a concrete pit in the pump-house floor, below the elevation of the engine but connected directly to it by piping.

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Building Inspections

Where an annual building inspection is made in the fall, is there any advantage in making a similar inspection in the spring? Why? If so, what items should be noted particularly?

Spring Inspections Discover Many Small Defects

By General Building Inspector

It is highly desirable that a formal inspection of buildings be made in the fall, since this permits the information necessary for the preparation of the annual budget to be assembled and thoroughly considered before the recommendations are submitted. As a part of this preparation, the schedules for doing the work and the bills of material required for making the repairs can also be prepared. In turn, this permits both purchases and deliveries to be made in an orderly manner and insures that the wanted items will be on hand in time for use.

No matter how thoroughly this inspection is made, however, many small defects, and frequently larger damage, almost invariably develop during the winter months, particularly in severe climates. For this reason, I consider it generally necessary to make a secondary inspection in the spring. At this time it is seldom necessary to bother about major structural defects, except in special cases, since these should have been covered during the fall inspection.

On the other hand, floors, doors and windows; siding, if the building is of frame construction; gutters and down-spouts, should all be inspected thoroughly. Roofs should be examined for leaks, broken tile or slate. Heating plants and chimneys should be gone over thoroughly. Plumbing, sewers and other drains should be inspected and the condition of platforms and driveways should be observed. Many of the defects discovered at this time will be of minor character, but they are annoying to the occupants, and if ignored, may eventually become important. Generally, little material is required for their correction, and most of the repairs can be made at the time the gangs are doing the work called for on the regular schedule. In other cases, they can be done by the "roustabout" repairmen maintained on most divisions.

Spring Inspections Are Desirable

By FRANK R. JUDD

Engineer of Buildings, Illinois Central, Chicago

On those roads that prepare budgets for maintenance expenditures, the time for making the annual building inspection is governed more by the time required to assemble the budget data than by the season of the year. Those roads that complete their budgets during the early months of the year are likely to schedule their annual inspections for early in the fall. There are some roads, however, that make their formal building inspections during the spring; where building maintenance is not budgeted, this would seem desirable.

Even if the annual inspection is made in the fall, I consider it wise to supplement this with a spring inspection, since at this time the troubles encountered during

the winter, when most building defects are revealed, are fresh in the minds of the occupants and there is less likelihood that they will fail to report conditions that cannot be detected readily by the usual means employed in making such inspections. Such defects as have developed during the winter can then be repaired while the major work already provided for is under way.

It is during the winter and early spring that many needed repairs such as leaks in roofs, defective smoke pipes or chimneys, defective doors, windows, floors, heating equipment, sewers, water lines, etc., are brought most forcibly to attention. This is particularly true of heating plants, which should be carefully checked at the conclusion of the heating season. These plants can then be put in first class condition during the summer, so that they will be ready for immediate service in the fall.

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Transposing Rails on Curves

To what extent is a road warranted in transposing the inner and outer rails on curves when they become worn? Are there any disadvantages?

Does Not Know of Any Disadvantages

By G. A. PHILLIPS
Chief Enginner, Delaware, Lackawanna & Western, Hoboken, N. J.

On the Lehigh Valley, with which I was connected until a few weeks ago, it was our regular practice to transpose rail on curves. I know of no disadvantages that result from doing this, provided the transposition is made before the low rail becomes too badly battered or the metal in the head has flowed too much. Transposition has increased the life of rails on curves materially; we estimated that it has been doubled, and has, therefore, saved a large amount of money which would otherwise have been spent for new rail.

When wear reaches a certain point, it is both desirable and economical to make the transposition. For example, we found that while rails can be left as they are in the track for several months after the time when they should be transposed, the low rails soon become so badly damaged that they cannot again be used in main tracks. If the rails are transposed before this damage occurs, however, a largely increased service life is obtained. For instance, on a curve where flange oilers are not used and the rail will last a year before being transposed, an additional service life of 15 to 16 months can be expected after transposition, or a total life of 27 to 28 months. The increased life after transposition is obtained as a result of the case hardening of the steel through the cold rolling action of the wheels during the first installation.

Mentions Two Disadvantages

By Supervisor of Track

Where the difference in speed between the fastest and slowest trains is relatively small, a nearly ideal condition is presented with respect to curve superelevation, and approximately the same weight is imposed on both rails. In such a situation, the transposal is economical and otherwise advantageous. If, on the other hand, there is a large proportion of slow-moving traffic, and particularly if such traffic preponderates, the metal on the running surface of the low rail flows and forms fins on both sides of the head, making it unsuitable for further use when released. In this event, the high rail should be reversed when it becomes worn to the established limit, and the low rail should be allowed to remain in place until it is ready to be removed from the track.

When conditions make it desirable to transpose the rails, the narrow head of the worn high rail reduces the slipping of the inside wheels and this in turn reduces the wear on both the rail and the wheels. The life of the rail is thus increased substantially over that which it would have had if it had been merely turned.

When making a transposal of rails, the joints on the outside rail, when it is laid on the inside of the curve, will run far ahead of those in the old low rail in its new position, making it necessary to cut rails for the low side, thereby doubling the number of short rails and adding to the inconvenience of replacing broken rails. Another item to be considered is that when the high rail is reversed it no longer fits the contour of the wheels of the locomotives and the tread contact is reduced. For this reason, the traction of the locomotive may be so greatly reduced that the transposal becomes impracticable on ascending grades or on a line where curve resistance is the deciding factor in determining the tonnage.

Service Life Can Be Greatly Extended

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

I am convinced that much economy would result from closer supervision of the rail on curves. On a road having both a heavy freight movement and high-speed passenger trains, curve elevation is always a compromise. While the speed of passenger trains can be restricted to conform with curve elevation, freight train speeds cannot be correspondingly accelerated, with the result that the low rail wears through flow of the metal from the running surface more rapidly than the high rail does from abrasion. In fact, where traffic is dense, our present open-hearth rails begin to show evidence of this flow shortly after they are laid.

If this condition is allowed to continue without attention, the low rail will soon become damaged beyond the possibility of salvage, the time required depending on several factors, the most important of which are the volume of traffic and the amount of superelevation. On the other hand, if at the proper time, which is usually determined in each instance from the condition of the low rail, the rails are transposed, the service life can be approximately doubled. While one or two minor difficulties are involved in making the transposal, there are no disadvantages, provided the change is made at the proper time.

[Several answers to this question were received, which space limitations do not permit us to publish in full. W. E. Tillett, assistant foreman, C. & O., advocated the use of released rail for relaying curves in preference to transposing the high and low rails, where new rail is not available. Julius M. Bischoff, office engineer, T. R. R. A. of St. Louis, called attention to the fact that because of the side wear on the head of the high rail, this rail acts as a frictionless rail when transposed. H. E. Herrington, section foreman, M. & St. L., favored transposing the rails and also discussed the advantage of the frictionless feature, as well as the additional service life that is obtained by making the transfer. L. M. Rodrek, section foreman, M. St. P. & S. S. M., said there is a decided advantage in transposing the rail on curves and no disadvantages, provided wear has not been allowed to progress too far before the change is made. J. Morgan, supervisor, C. of Ga., favored making the transposal, with the proviso that the high rail should not be turned while this should always be done with the low rail.—Editor]

News of the Month . . .

Carloadings Show Further Increase

Weekly freight carloadings this year continue to show increases over those of the corresponding weeks of 1933 and more recently also over 1932. For the week ending February 17, freight cars loaded totalled 598,896, an increase of 81,367 cars over the corresponding week of 1933 and of 26,631 cars over the same week in 1932. Carloadings are now at a higher level than at any time since the middle of last November. They have risen steadily for seven consecutive weeks.

Express Service Now 95 Years Old

Railway express service in the United States will be 95 years old on March 4, according to a recent statement of the Railway Express Agency. Historical records, the statement says, show that William H. Harnden, conductor on a pioneer New England railroad, originated the personal service idea in express transportation, by carrying packages in his carpetbag between New York and Boston. His business grew so rapidly that he could employ others and had many competitors who laid the foundation of the several express companies of the pre-war era.

Tie Stocks of Producers Increase

Fourteen companies supplying approximately 85 per cent of the crossties produced by commercial firms had 6,855,880 crossties in stock on January 1, which was 984,081, or 16.8 per cent, more ties than these companies had in stock on January 1, 1933, according to reports filed with the Railway Tie Producers Association. The number of ties in stock has increased 35 per cent since last August when the number of ties available in the yards of these companies amounted to 5,063,020. Prior to August, tie stocks showed a steady decline from January, 1932.

Railroad Taxes in 1932 Equalled 38 Per Cent of Net

Class I railroads of the United States in 1932 paid 38.04 cents in taxes out of each dollar of net earnings to the various federal, state and local governments, which was the highest ration for any year since 1920, according to a study of railroad taxation completed recently by the Bureau of Railway Economics. In 1931 the railroads paid 31.46 cents per dollar in taxes, and in 1930, 25.81 cents. On the basis of total operating revenues, the railroads in 1932 paid for taxes 8.8 cents out of each dollar received, the highest ratio for any year on record. "Total taxes paid by railways of Class I in 1932 amounted to $275,135,399," according to the report. "State and local governments received $262,705,576 of the total, or 95.5 per cent, while the federal government received $11,928,446, or 4.3 per cent; the remaining $504,377, or 0.2 per cent, was credited to accounts of countries across our national boundary lines."

Airline Traffic Increases in 1933

Scheduled airlines in the United States flew more miles and carried more passengers and express in 1933 than in any previous year, according to an announcement by Eugene L. Vidal, director of aeronautics in the Department of Commerce. Domestic airlines carried 493,141 passengers in 1933, as compared with 474,279 in the previous year. Merchandise and other articles dispatched by air express amounted to 1,510,215 lbs., an increase of nearly 50 per cent over the 1,033,970 lbs. carried in 1932. Miles flown were 48,771,553 in 1933, as compared with 45,606,354 in 1932 while passenger miles flown totaled 173,492,119 as against 127,038,798 in 1932.

Illinois Central to Build Two Bridges Totalling 20,000 Ft.

Construction is about to commence on two unusually long bridges to carry the Illinois Central and its affiliated line, the Yazoo & Mississippi Valley, across the Bonnet Carre spillway, a government flood control project on the Mississippi river about 30 miles above New Orleans, La. The construction work is to be carried out under an agreement with the federal government whereby the government will reimburse the railroad for the expense of constructing the bridges. The Illinois Central bridge will be a double-track, creosoted, ballasted-deck trestle having a total length of 12,000 ft., with the continuity of the timber structure interrupted at intervals of 1,000 ft. by a steel deck girder span. The bridge carrying the Y. & M. V. will be a single-track structure of similar construction 8,000 ft. long flanked at each end by a 500 ft. embankment. The construction of the two bridges will require 1,110,000 lin. ft. of creosoted piling, from 70 ft. to 90 ft. long; 5,840,000 ft. b. m. of creosoted timber; 8,400 cu. yd. of concrete; 12,000 lin. ft. of untreated piles; and 1,000 tons of structural steel.

Photo-Electric Cells Open Station Doors

Doors which open automatically upon the approach of a person, and which remain open until he has passed through, have been installed in the Pennsylvania Station, New York, between the waiting room and the train concourse. The doors open on the approach of a person from either direction, and although they may have started to close, they will reopen from any position upon the approach of a person. The doors are operated in pairs and are caused to open by the interruption of a light beam shining on a Photronic photo-electric cell, the light source and the cell being located in uprights of guide rails on opposite sides of the approaches to the doors.

Streamlined Train Delivered to Union Pacific

The high-speed three-car, articulated, all-aluminum streamlined train which was ordered by the Union Pacific from the Pullman Car & Manufacturing Corporation was delivered to the railroad by the builder on February 12, at Pullman, Ill. At the same time, W. A. Harriman, chairman of the board of the Union Pacific announced that contracts have been awarded to the same builder for three additional trains of similar design, one six-car train and two nine-car trains, all of which will have sleeping cars. With these trains the railroad expects to reduce the schedule between Chicago and the Pacific Coast 24 hr. Delivery of the three-car train was accompanied by a ceremony that included a broadcast over the National Broadcasting network of a description of the train and of addresses by Mr. Harriman; C. R. Gray, president of the Union Pacific; C. F. Kettering, president of General Motors Research Corporation; and R. A. Hunt, president of the Aluminum Company of America. During the remainder of the month the train was on exhibition successively at Washington, D. C., Baltimore, Md., Pittsburgh, Pa., Detroit, Mich., Chicago, and Omaha, Neb.

Train Service Hit by Heavy Snows in East

Extensive demoralization of train, highway and air service in the East and in New England followed in the wake of two heavy snow storms coming in rapid succession, one on February 19 and the other on February 25. During the first storm, about 9 in. of snow fell in New York City, and as much as 22 in. in parts of New York and Connecticut, and even more in certain places on Long Island. During the second storm about 10 in. of snow fell in the New York Metropolitan area and considerably more in the surrounding territory including Long Island. On the occasion of both storms through trains were delayed from 30 min. to as much as several hours, and, in the New York Metropolitan area, commuter service was seriously disrupted, being practically abandoned for a number of hours in certain of the suburban areas of Long Island. The most serious delays were between New York and Boston, a number of trains being stalled for hours at small towns along the line. During the second day of the first storm the New York, New Haven & Hartford annulled nearly all of its through trains. Snow-fighting equipment of all types was brought into active service on all the railroads involved and many extra laborers were given employment in restoring railroad service to normal as quickly as possible.

Association News

International Railway Maintenance Club

The first quarterly meeting of the International Railway Maintenance Club for this year was held at the Statler Hotel, Buffalo, N. Y., on February 8. John A. Reed, sales engineer of the Carnegie Steel Corporation, Pittsburgh, Pa., addressed the meeting on GEO track construction, his address being accompanied by slides showing various installations.

American Railway Engineering Association

Final arrangements have been completed for the thirty-fifth annual convention of the American Railway Engineering Association, which will be held on March 13 and 14 at the Palmer House, Chicago. The program follows:

Tuesday Morning

President's address, W. P. Wiltsee, chief engineer, Norfolk & Western. Reports of secretary and treasurer. Reports of Committees on:

Uniform General Contract Forms
Yards and Terminals
Rules and Organization
Records and Accounts
Roadway

Tuesday Afternoon

Clearances
Ballast
Track
Buildings
Shops and Locomotive Terminals
Maintenance of Way Work Equipment
Waterproofing Railway Structures

Tuesday Evening

Rail
Stresses in Railroad Track

Wednesday Morning

Ties
Wood Preservation
Water Service and Sanitation
Signals and Interlocking
Electricity
Wooden Bridges and Trestles
Masonry

Wednesday Afternoon

Grade Crossings
Rivers and Harbors
Iron and Steel Structures
Economics of Railway Location
Economics of Railway Operation
Economics of Railway Labor
Standardization

On Wednesday noon a luncheon will be served in the Red Lacquer room of the Palmer House for members and guests, at which Dr. A. A. Potter, dean of engineering at Purdue University, will give an address on "Research as Applied to Railroading."

Two committees held meetings during the month, namely, the Committee on Rail at New York on February 15, and the Committee on Iron and Steel Structures at Cincinnati February 8 and 9, with, an attendance of 15. However thirteen of the committees have already arranged to hold meetings at Chicago during the week of the convention.

On Monday, March 12 there will be meetings of the Committee on Ballast and the Special Committee on Complete Roadway and Track Structures, in addition to a meeting of the Board of Direction.

On Tuesday there will be meetings of the committees on Economics of Railway Labor; Rules and Organization, Ties, Economics of Railway Operation, Masonry, Yards and Terminals, Records and Accounts, Track, and on Water Service, Fire Protection and Sanitation, in addition to a meeting of the General Committee of the Engineering Division of the A. R. A. The Committee on Waterways and Harbors will hold a meeting on Wednesday.

Maintenance of Way Club of Chicago

Col. W. G. Arn, assistant engineer, Illinois Central, was the speaker at the meeting on Wednesday evening, February 21, following a dinner served to 35 members and guests. Col. Arn read a paper on the effect of brine drippings on the corrosion of rails and track fastenings and bridge members, and dealing with the problem imposed by an effort to prevent the dripping of brine from cars, as well as measures taken to protect parts of the tracks and structures from the corrosive effect of the brine.

Metropolitan Track Supervisors' Club

The next meeting of the Metropolitan Track Supervisors' Club is scheduled to be held on March 7, at Keen's Chop House, New York City, having been postponed from February 28 because of the severe storms in the New York Metropolitan area. Following dinner, N. D. Howard, eastern editor, *Railway Engineering and Maintenance*, will present a paper entitled Economical Track Maintenance Demands Clean Ballast, which is published elsewhere in this issue. Following the paper, motion pictures will be shown of several modern types of ballast cleaning equipment in operation.

Class I Railroads in 1933 Earn 474 Million

Class I railroads in 1933 had a net railway operating income of $474,369,438, a return of 1.80 per cent on their property investment, as compared with a net of $326,317,936, or 1.24 per cent, in 1932, according to reports compiled by the Bureau of Railway Economics. Freight revenue amounted to $2,492,735,344 in 1933, as compared with $2,450,957,092 in 1932, an increase of about two per cent. Passenger revenue in 1933 amounted to $329,341,854, a decrease of $47,753,519, or 12.7 per cent, as compared with 1932. Total operating revenues in 1933 amounted to $3,095,446,191, compared with $3,126,889,091 in 1932, a decline of 1 per cent. Thirty-three Class I railroads operated at a loss in 1933.

Personal Mention

General

F. L. Thompson, vice-president in charge of engineering of the Illinois Central, with headquarters at Chicago, has had his jurisdiction extended to include the maintenance of way department. Heretofore jurisdiction over this department has been vested in the operating vice-president.

Engineering

C. J. Henry, a supervisor of track on the Pennsylvania, with headquarters at West Philadelphia, Pa., has been promoted to division engineer, with headquarters at Philadelphia.

Track

G. C. Harris, a roadmaster on the St. Louis-San Francisco, has had his headquarters moved from Oronogo Jct., Mo., to Baxter Springs, Kan., and **C. E. Armstrong,** roadmaster at Wichita, Kan., has had his headquarters moved to Beaumont, Kan.

H. H. Gudger, an extra gang foreman on the Missouri Pacific, has been promoted to roadmaster on the Memphis division, with headquarters at Marianna, Ark., succeeding **C. J. Jaeschke,** who has been transferred to St. Louis, Mo., where he replaces **W. Rambo.** Mr. Rambo has been transferred to Poplar Bluff, Mo., to succeed **A. F. Riss,** who has retired from active service.

M. E. Spivey has been appointed acting roadmaster on the Atchison, Topeka & Santa Fe, with headquarters at Parker, Ariz., to succeed **C. I. Jones,** who has been transferred to Barstow, Cal., where he replaces **H. L. Hoskins,** who has been transferred to Oceanside, Cal.

Milton E. Leavitt, formerly assistant track supervisor on the Portland division of the Boston & Maine, with headquarters at Lawrence, Mass., has been promoted to track supervisor, with headquarters at Portsmouth, N. H., succeeding **Raymond H. Mitchell,** who has been transferred to the Terminal division, with headquarters at Salem, Mass., succeeding **Ralph F. Macaulay,** resigned. **Dana Burroughs,** former extra crew foreman on the Terminal division has been appointed assistant track supervisor, with headquarters at Lawrence, Mass., where he succeeds Mr. Leavitt.

Mr. Leavitt was born in May, 1904, at Manchester, N. H., and entered railway service on July 3, 1922, in the mechanical department of the Boston & Maine, being transferred to the engineering department as a chainman on December 14, 1925. On June 7, 1926, he was promoted to rodman and on March 1, 1928, he became a transitman. From September 24, 1929, to Oc-

tober 14 of the same year he was acting assistant engineer, and in November of that year he was promoted to assistant track supervisor. On February 1, 1933, he became acting track supervisor.

A. H. Stimson, assistant supervisor on the Maryland division of the Pennsylvania, has been promoted to supervisor on the Cincinnati division, with headquarters at London, Ohio. **W. C. Gretzinger,** assistant supervisor on the New York division, has been promoted to supervisor on the Maryland division, with headquarters at Media, Pa. **K. A. Werden,** assistant supervisor on the Middle division, has been promoted to supervisor on the Buffalo division, with headquarters at Oil City, Pa. **J. B. Jones,** assistant supervisor on the Philadelphia division, has been promoted to supervisor on the Williamsport division, with headquarters at Lock Haven, Pa. **M. C. Fox,** assistant supervisor on the Middle division, has been transferred to the Maryland division, with headquarters at Perryville, Md. **L. G. Walker** has been appointed assistant supervisor on the Delmarva division, with headquarters at Clayton, Del. **A. W. Miller,** assistant supervisor on the Delmarva division, has been transferred to the Middle division, with headquarters at Newport, Pa. **F. E. Flynn,** supervisor on the Cincinnati division, has been transferred to the Philadelphia division, with headquarters at Harrisburg, Pa. **N. D. Vernon,** supervisor on the Philadelphia division, has been transferred to the Wilkes Barre division, with headquarters at Buttonwood, Pa. **R. W. Speidle** has been appointed assistant supervisor on the Baltimore division, with headquarters at Washington, D. C., and **G. C. Vaughn** has also been appointed assistant supervisor on the Baltimore division, with headquarters at Washington. **A. J. Neafie,** has been appointed assistant supervisor on the Baltimore division, with headquarters at York, Pa. **L. P. Oelschlager,** assistant supervisor on the Philadelphia division, has been transferred to the Middle division, with headquarters at Huntington, Pa. **E. L. Rankin,** assistant supervisor on the Philadelphia division, has been transferred on the same division to Harrisburg, Pa. **R. DeJaiffe** has been appointed acting assistant supervisor on the Philadelphia division, with headquarters at Enola, Pa. **H. D. Kruggel,** supervisor on the Williamsport division, has been transferred to the Eastern division, with headquarters at Mansfield, Ohio. **C. W. Robinson,** assistant supervisor on the Pittsburgh division, has been transferred to the Philadelphia division, with headquarters at Middletown, Pa.

Bridge and Building

H. M. Baker, assistant bridge and building supervisor on the Missouri Pacific, at Poplar Bluff, Mo., has been transferred to Monroe, La.

J. N. McConnell, bridge and building master on the Woodstock division of the Canadian Pacific, with headquarters at Woodstock, N. B., has been transferred to the Montreal Terminals division, at Montreal, Que., succeeding **W. F. Koehn,** who has been transferred to the Laurentian division, with the same headquarters, replacing **H. M. Farmer,** who has retired from active service.

Obituary

F. T. O'Dowd, who retired about seven years ago as a roadmaster on the Southern division of the Atchison, Topeka & Santa Fe, with headquarters at Cleburne, Tex., died on December 30.

F. W. Rieck, until recently a roadmaster on the St. Louis-San Francisco, with headquarters at Chaffee, Mo., died on December 27. Because of ill health Mr. Rieck was forced to assume lighter duties several months prior to his death.

Charles S. Churchill, formerly chief engineer of the Norfolk & Western, who retired in 1926 as vice-president in charge of purchases, real estate and valuation of this company, died on January 25. Mr. Churchill was born on September 22, 1856, at New Britain, Conn., and was educated in civil engineering at Sheffield Scientific School, Yale University. He first entered railway service in 1879 and was engaged in the location of projected railroads in Connecticut for a year, then becoming engaged on the construction of the Meadville & Linesville (now part of the Bessemer & Lake Erie). From July, 1881, to January, 1884, Mr. Churchill was engaged on the location and construction of the Pittsburgh, McKeesport & Youghiogheny (now part of the Pittsburgh & Lake Erie) and during the following three years he was principal assistant engineer of construction on a branch of the Pennsylvania, then becoming engineer maintenance of way of the Shenandoah Valley (now part of the N. & W.). On October 1, 1888, following a brief period of service in the construction department of the N. & W., Mr. Churchill was advanced to engineer maintenance of way of that road, which position he held until 1903 when he was made chief engineer. In 1914, he was made assistant to the president in charge of federal valuation, then being appointed corporate vice-president in 1918. From March 1, 1920, until his retirement in 1926, Mr. Churchill served as vice-president in charge of purchases, real estate and valuation. Mr. Churchill was a past-president of the American Railway Engineering Association and was active in the affairs of various other technical and railroad organizations.

Charles S. Churchill

Joseph B. Hutchinson, who was formerly assistant engineer maintenance of way and construction on the Pennsylvania and later general manager and assistant to vice-president, died at his home at Bryn Mawr, Pa., on February 12. Mr. Hutchinson was born on March 20, 1844, at Bristol, Pa., and was educated at the Polytechnic College of Pennsylvania. He entered railway service in June, 1863, as a rodman on construction on the Pennsylvania and in August, 1864, he was made an assistant engineer of construction, being appointed assistant engineer maintenance of way and construction in May of the following year. From March, 1868, to July, 1870, Mr. Hutchinson served as an assistant engineer at various points on the Pennsylvania and at the end of this period he was made principal assistant engineer on the Columbia & Port Deposit branch. In July, 1877, he was promoted to assistant superintendent and two years later he was further advanced to superintendent, serving in this position on various divisions until March 1, 1893, when he was made general superintendent of transportation of the lines east of Pittsburgh and Erie. In 1897, Mr. Hutchinson was promoted to general manager and in 1903 he was made assistant to vice-president, serving in this position under various vice-presidents until his retirement in 1914.

William A. Christian, formerly first assistant engineer of the Chicago Great Western, died on February 4 at Chicago at the age of 63 years. During his career as a civil engineer Mr. Christian served in the engineering departments of a number of railroads. He was born on November 21, 1870, at St. Louis, Mo., and was educated in both civil engineering and medicine, although he never followed the latter profession. Early in his career he served a total of two years as a chainman and rodman with the Chesapeake & Ohio, the Baltimore & Ohio, and the Cleveland, Cincinnati, Chicago & St. Louis, later serving as assistant engineer maintenance of way of the latter road. Mr. Christian spent three years as a draftsman with the Stacey Bridge Company, Cincinnati, Ohio, and nine years on the location, design and construction of locks and dams with the government. He entered the service of the Chicago Great Western in 1906 as an assistant engineer at St. Paul, Minn., being promoted to first assistant engineer at Chicago in 1909. Five years later Mr. Christian left railway service to become senior roadway engineer at Chicago in the Bureau of Valuation of the Interstate Commerce Commission. Following the completion of this work he spent a year with the health department of the City of Chicago, two years in private practice, three years in the engineering department of the Chicago & Western Indiana as an assistant engineer, and since 1931 has been connected with the United States Engineer office at Chicago.

Woodings Gauging Tool

Will Facilitate Fall Gauging and Rail Laying

Reduces labor customarily required to pull rails and holding them to gauge while spiking

Jabbing of picks into ties is eliminated

Tool is operated by one man

Can be used on all rail sections from 60 lb. to 152 lb.

Made of best quality double strength pipe and highest grade steel castings thoroughly insulated

Light in weight—20 pounds

A Husky Time Saving Tool Designed for Rough Service

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VERONA, PA.

Supply Trade News

General

The Howe Scale Company, Rutland, Vt., has moved its New York office, warehouse and repair shop to the Port Authority Commerce building, 111 Eighth avenue.

The Century Wood Preserving Company, Inc., Boston, Mass., has moved its offices to the Boston Consolidated Gas Building, 250 Stuart street.

William B. Joyce, Beverly, Mass., and the **Associated Manufacturers' Agencies,** Louisville, Ky., have been appointed representatives of the **Northwestern Motor Company,** Eau Claire, Wis.

The Air Reduction Company, Inc., New York, on January 1 exercised its option to purchase the balance of the capital stock of the **Wilson Welder & Metals Company** of North Bergen, N. J. The Air Reduction Company thus becomes the first of the oxyacetylene welding companies to own a 100 per cent interest in an electric welding organization.

The Ross & White Company, Chicago, has executed a contract with **Wonham, Inc.,** New York, whereby the latter concern will act as export sales manager for the Ross & White Company in foreign countries for locomotive coal, sand and cinder plants and equipment. The Ross & White Company has appointed **John J. O'Fallon,** of the O'Fallon Company, St. Louis, Mo., its representative in that city.

The subsidiary manufacturing companies of the **United States Steel Corporation** have organized and established a **Railroad Research Bureau** to engage in developmental work for the benefit of the railroad industry and its suppliers. **John A. Ralston** is manager of the bureau, which has its headquarters in the Frick building annex, Pittsburgh, Pa. Engineering and experimental work of this department will be closely co-ordinated with the activities of the subsidiary manufacturing companies, in the interest of rendering service to all who are concerned with the application of rolled steel products to the construction of railroad equipment. A series of high tensile steels are being produced and offered to the trade by the companies co-operating in and with the Railroad Research Bureau. Grades and products suitable for a variety of requirements are available for the execution of new designs, which have as their purpose a reduction in weight without attendant sacrifice of strength.

Personal

T. R. Wyles, who has been associated with the **Armstrong Paint & Varnish Works,** Chicago, and who was formerly vice-president and chairman of the board of the **Detroit Graphite Company,** Detroit, Mich., has been appointed secretary of the **Steel Plate Fabricators' Association,** which is the trade organization that will be the code authority for that industry under the N. R. A., with headquarters at 1070 Old Colony building, Chicago.

W. P. Greenawalt has joined the staff of the **Ingot Iron Railway Products Company,** and will be attached to its Chicago office.

Howard C. Mull, vice-president of the **Warren Tool Corporation,** Warren, Ohio, has been made chairman of the Transportation and Traffic Committee of the Warren, Ohio, Chamber of Commerce.

Harry G. Chapman, vice-president and general manager of the Cyclone Fence Company, a subsidiary of the United States Steel Corporation, with headquarters at Waukegan, Ill., died in Pittsburgh, Pa., on January 30, following a heart attack.

W. B. Joyce, Beverly, Mass., has been appointed sole New England representative for the **Ruby Railway Equipment Company,** Philadelphia, Pa. **A. W. Boorom,** New York, who formerly covered this territory, will continue to represent the company in the New York area.

R. G. Russell, vice-president and general manager of the **Standard Fence Company,** the Pacific Coast subsidiary of the **Cyclone Fence Company,** Waukegan, Ill., has been elected vice-president and general manager of the latter company, to succeed **Harry G. Chapman,** deceased.

John DeMooy has been appointed sales manager and **Albert F. Barnes** has been elected secretary of the **Cleveland Pneumatic Tool Company,** Cleveland, Ohio. In these positions Mr. DeMooy and Mr. Barnes succeed to the duties of **H. S. Covey,** secretary and sales manager, who has voluntarily resigned after 35 years service with this company. Mr. Covey has also resigned as vice-president of the **Cleveland Pneumatic Tool Company of Canada, Ltd.,** and of the **Cleveland Pneumatic Tool Company.**

I. B. Tanner, president, **G. T. Willard,** vice-president, and **F. M. Condit,** secretary, of the **International Rail Welding Corporation,** Chicago, have resigned and **S. E. Purdy,** chairman of the board, has been appointed acting president. The **Tanner-Willard Company,** St. Louis, Mo., has been organized by Mr. Tanner and Mr. Willard to design and construct railroad water service and treating plants, contract for the renewing of rail ends by the direct current arc-welding method and act as manufacturers' agents of maintenance of railway equipment and materials.

Arthur H. Young has been appointed vice-president in charge of industrial relations of the United States Steel Corporation, with headquarters at New York. From 1899 to 1917 Mr. Young held various positions at the plants and in the operating departments of the Illinois Steel Company and the Colorado Fuel & Iron Company. During 1917 and 1918 he served as director of the American Museum of Safety in New York, and later for six years was manager of industrial relations of the International Harvester Company. Since 1924, Mr. Young has been director of Industrial Relations Counselors, Inc., New York.

Trade Publications

Strength of Corrugated Iron Pipe.—The Armco Culvert Manufacturer's Association, Middletown, Ohio, has issued an eight-page folder containing examples and illustrations designed to show the superior strength of corrugated iron culverts under adverse conditions.

Electrical Equipment for Maintenance of Way—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued a 60-page attractively printed and illustrated booklet entitled "Electrical Equipment for Railroad Shops and Maintenance of Way" in which are described the many different types of electrical equipment—with railroad applications that are manufactured by this company. The various subjects discussed include: Arc-Welding Maintenance of Way; Electric Heat Treating and Melting; Water Service Electrification; Coaling and Ash Handling Facilities, Turntables, Cranes and Hoists; and Electrified Tools for Maintenance of Way.

The Cement Gun and Gunite—The Cement Gun Company, Allentown, Pa., has published a 50-page booklet, designated as Bulletin 200, which contains complete information regarding the Cement Gun and Gunite. Following a description of the gun and a tabulation of the physical properties of Gunite the bulletin describes the various tests to which Gunite has been subjected in order to determine its suitability for various applications. About 40 pages of the booklet are taken up by illustrations and descriptive matter concerning the many different applications of Gunite.

Self-Priming Centrifugal Pumps—A handbook entitled Performance and Test Standards for Self-Priming Centrifugal Pumps has been published by the LaBour Company, Inc., Elkhart, Ind. This book comprises a treatise on the standards for measuring all centrifugal pumps of the self-priming type. It is divided into four parts as follows: (1) Definitions and Qualifications; (2) Self-Priming Centrifugal Pump Standards; (3) Tests; and (4) Factory Test Equipment. Two appendices containing basic formulas and data, and operating information are given in the back of the book.

Timken Engineering Journal—The Timken Roller Bearing Company, Canton, Ohio, has published a 266-page loose leaf book containing general information concerning the various types of Timken bearings. The book first outlines the principles entering into the design of bearings and then describes and illustrates the various types of Timken bearings that are in standard production. The next section explains the new load ratings conforming to the fatigue life of the bearings and also gives the methods of calculating loads and selecting bearings. This is followed by a statistical presentation of the bearings available in the various types, while the next section, consisting of more than 100 pages, is known as the Dimension Sheet section and contains full size drawings of the various bearings.

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BOLT TIGHTENING

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IN 1932 a total of 402,566 of rails were rolled. ● In 1933 this tonnage totaled 353,385. ● Although 1934 is only two months old, less than 35 railroads have already ordered or made definite arrangements to order more than 600,000 tons of rails. ● Rail has long been recognized as the foundation of track. ● Rail orders are just as definitely a barometer of maintenance of way expenditures. ● With railway carloading (and earnings) increasing at an accelerating rate, funds are becoming available for more liberal expenditures. ● Confronted with demands from all quarters, maintenance of way officers must determine which needs shall be given first consideration. ● That manufacturer will profit most who presents his story most convincingly.

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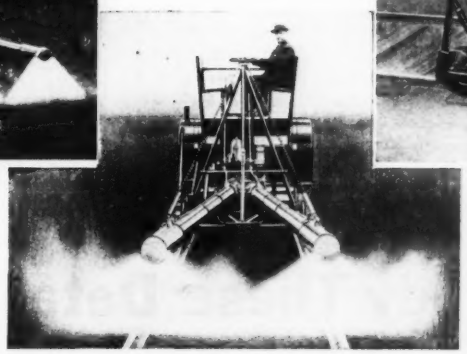

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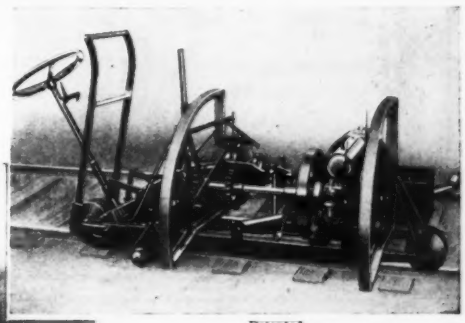

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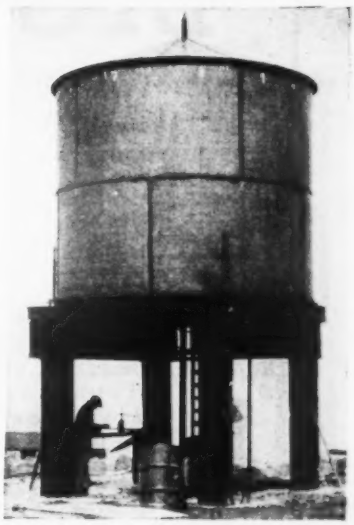
NO-OX-ID IRON-RUST The Original Rust Preventive



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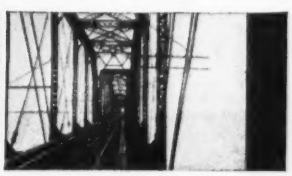
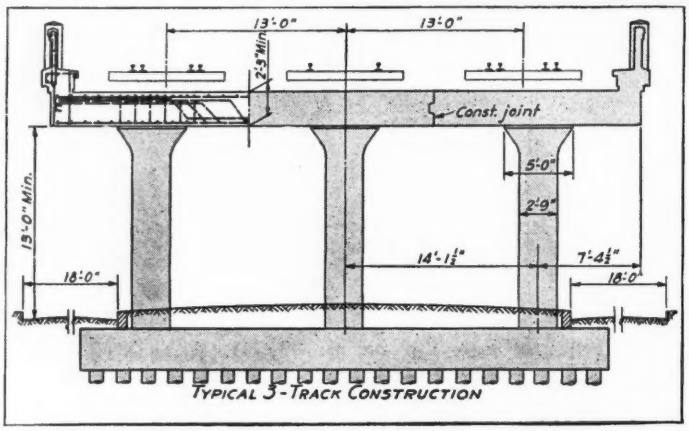
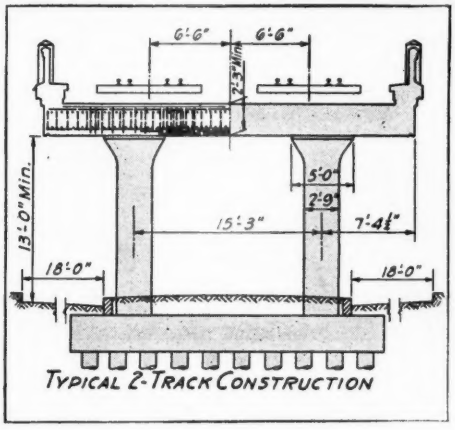




TYPICAL 3-TRACK CONSTRUCTION



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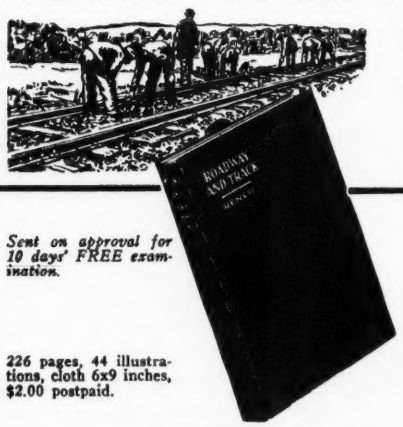

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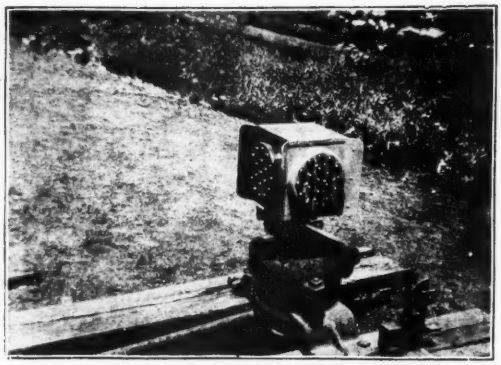

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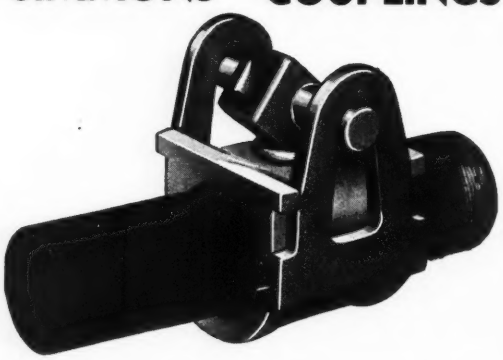

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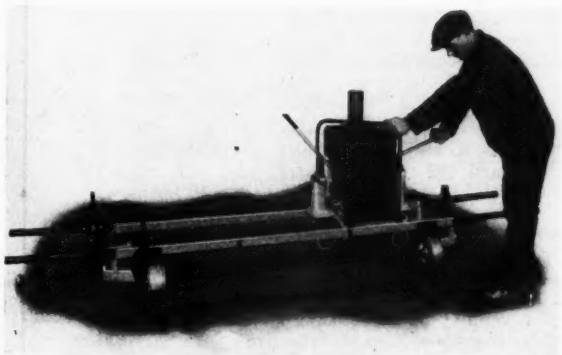

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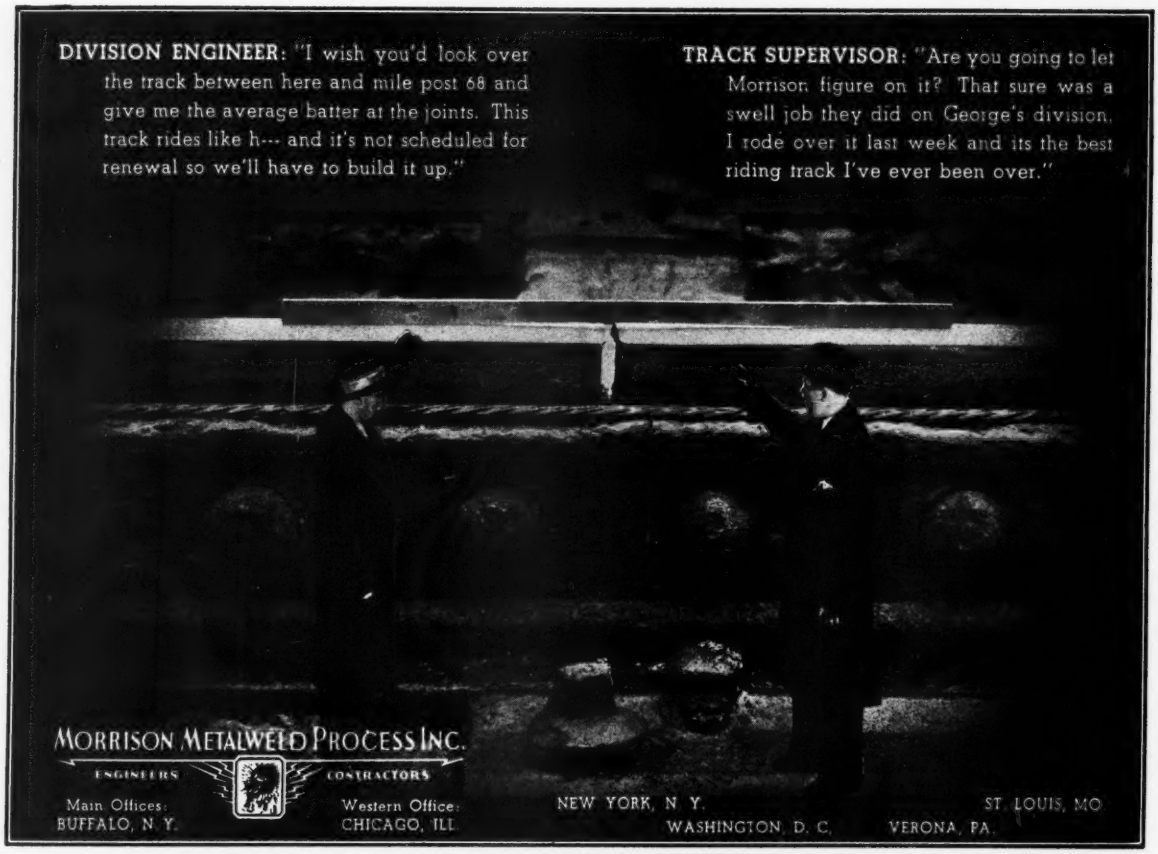
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